TO 31R2-2TRC207-1

OPERATION AND MAINTENANCE INSTRUCTIONS WITH ILLUSTRATED PARTS BREAKDOWN

ORGANIZATIONAL LEVEL

RADIO SET AN/TRC-207
(BI-DIRECTIONAL REPEATER)

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SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedure, and do not appear elsewhere in this manual. These Safety Summaries are recommended precautions that all personnel must understand and apply during any given phase of operation and maintenance. Each chapter has other specific warnings and cautions.

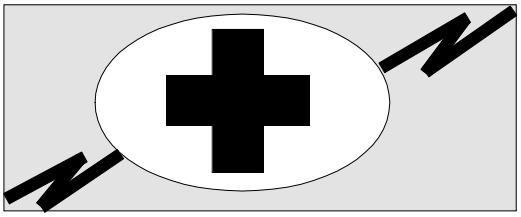
WARNING

KEEP AWAY FROM LIVE CIRCUITS

Personnel must at all times observe all safety regulations. Do not replace components or make adjustments inside equipment with power turned on. Under certain conditions, dangerous voltages may exist when the power switch is in the off position due to charges retained by capacitors. To avoid injury, always remove power and discharge and ground a circuit before touching it.

RESUSCITATION

Personnel working with or near high voltages should be familiar with modern methods of resuscitation. Such information may be obtained from the Director of Base Medical Services.



WARNING

LITHIUM BATTERIES

Lithium oxide batteries or cells may be used in the battery enclosure and receiver-transmitters used in this equipment. They are potentially hazardous if misused or tampered with before, during or after discharge. The following precautions must be strictly observed to prevent possible injury to personnel or equipment damage.

Do not heat, incinerate, crush, puncture, disassemble, or otherwise mutilate the batteries.

Do not short-circuit, recharge, or bypass internal fuse.

Do not store batteries in equipment during long periods of non-use (in excess of 30 days).

Turn off the equipment immediately if you detect battery compartment becoming unduly hot, hear battery cells venting (hissing sounds), or smell irritating sulfur dioxide gas.

WARNING

VOLTAGES WITHIN THIS EQUIPMENT ARE HIGH ENOUGH TO ENDANGER LIFE.

Covers are *not* to be removed except by persons qualified and authorized to do so and these persons should always take extreme care once the covers have been removed.

Page	
2-1	WARNING - Installation of the bi-directional repeater requires a minimum of two people.
2-1	WARNING - Removing the bi-directional repeater assembly from the shipping carton requires a minimum of two persons.
2-5	WARNING - Ensure proper use of safety tools (work gloves and hard hat) during assembly and disassembly of antenna.
2-6	WARNING - Before using the hammer, ensure a wedge is placed in the top of the hammer so that the hammer head does not come loose, thereby endangering personnel.
3-3, 6-10, 6-12	WARNING - Before performing removal/replacement procedures, make sure power is removed from the unit by disconnecting from power source. Failure to do so could result in personal injury or equipment damage.
6-11	WARNING - This equipment is capable of generating RF power sufficient to cause RF burns. During transmit, care should be taken to eliminate the possibility of touching exposed RF output points such as the center conductors of coaxial cables or antenna feedpoints.
2-1	CAUTION - Exercise care when removing units from packing material in order to prevent damage to the unit.
3-3	CAUTION - Never apply pressure sensitive tape directly to connectors. This could damage connector pins.
3-3	CAUTION - Package all electrostatic discharge (ESD) sensitive assemblies in ESD bags before shipping or storing.
3-3	CAUTION - Rough handling may cause unnecessary damage to electronic assemblies.
3-3	CAUTION - Electronic assemblies containing solid-state devices are susceptible to damage from static electrical discharges. Wear protective clothing and grounded wrist straps
3-3	CAUTION - Forcing any tilted or cocked electronic assembly into position may result in bent or broken pins.
3-4	CAUTION - When repairing an electronic assembly, be careful that the tool employed does not inadvertently press against leads, pins, or other parts that are easily bent.
3-4	CAUTION - Because of the miniaturization of parts for electronic assembly construction, the leads, connectors, and pins have been stiffened to make them more rugged. As a result, such parts are brittle and will break easily if bent too often or pulled on too hard. When handling an assembly that has been removed from its chassis, be careful not to press against the leads and pins. When removing an assembly, be sure to pull it straight out from the equipment. Do not cock, twist, pry, or carelessly jerk an electronic assembly to remove it from the mounting or connector.
3-4	CAUTION - The bi-directional repeater contains components that are susceptible to damage by static electrical charges. Disassembly of the bi-directional repeater should only be done at a properly grounded work station.
6-12	CAUTION - The bi-directional repeater contains components that are susceptible to damage by static electrical charges. Disassembly of the bi-directional repeater should only be done at a properly grounded work station.

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FOREWORD

This manual meets the technical content requirements of specification MIL-M-38798B, paragraph 3.3 (1 December 1975) and MIL-M-38807A (1 June 1982) and format requirements of specification MIL-M-38784B (16 April 1983) for the bi-directional repeater.

a. Chapter 1 - General Information. This chapter provides general information for the bi-directional repeater including equipment description and purpose, leading particulars, capabilities and limitations, equipment supplied, equipment required but not supplied, optional equipment, special tools and test equipment, and related technical manuals.

b. Chapter 2 - Installation. This chapter provides complete installation instructions for the receiver-transmitter including installation logistics and installation procedure.

c. Chapter 3 - Preparation for Use and Reshipment. This chapter contains information which will permit operation and maintenance personnel to prepare the equipment for use, including reference to post-installation checkout procedures, preparing the unit for reshipment, packing, handling, and storage procedures.

d. Chapter 4 - Operation. This chapter provides complete operating instructions for the bi-directional repeater.

e. Chapter 5 - Theory of Operation. This chapter provides complete theory of operation for the bi-directional repeater.

f. Chapter 6 - Maintenance. This chapter provides all instructions required for on-equipment and off-equipment maintenance of the bi-directional repeater. It includes preventive maintenance, troubleshooting procedures, and repair procedures.

g. Chapter 7 - Illustrated Parts Breakdown (IPB). The IPB provides complete illustrated parts breakdown for the bi-directional repeater. The IPB is prepared in accordance with MIL-M-38807A.

h. Chapter 8 - Circuit Diagrams. This chapter contains the BDR interconnection diagram.

i. Glossary - The glossary provides a definition of the special terms and abbreviations used in the technical order.

j. Alphabetical Index - The index provides cross-references to applicable paragraphs, figures or tables.

Legend for Figure 1-1:

1. Bi-directional Repeater (BDR) Assembly (A1)
2. Cable Assembly, PS Power (W1)
3. Cable Assembly, Coaxial, RF (W2)
4. Strap Assembly, Ground (W5)
5. Power Supply (A2) (includes Power Supply Enclosure and Battery Enclosure)
6. Cable Assembly, Coaxial, RF (W4)
7. Weldment, Repeater Frame
8. Diplexer Assembly, 30-88 MHz (A3)
9. Cable Assembly, Coaxial, RF (W3)
10. Strap Assembly, Ground (W6)
11. Strap Assembly, Ground (W7)
12. Antenna, 403-470 MHz
13. Antenna, Mast, TR
14. Antenna, 136-174 MHz
15. Antenna, 30-88 MHz
16. Receiver-Transmitter RT-1695/TRC-199 Unit (A4, A5)

16a. Additional transceiver modules (p/o Receiver-Transmitter RT-1695/TRC-199)

17. Diplexer Assembly, 136-174 MHz (A3)
18. Case, Transit, Diplexer
19. Diplexer Assembly, 403-470 MHz (A3)
20. Rod Assembly, Ground
21. Cable, Coaxial, Antenna (W10)
22. Cable Assembly, 240 VAC, Power (W9)
23. Cable Assembly, 120 VAC, Power (W9)
24. Cable Assembly, 10-32 VDC, Power (W9)
25. Case, Transit, Diplexer
26. Cover, Frame

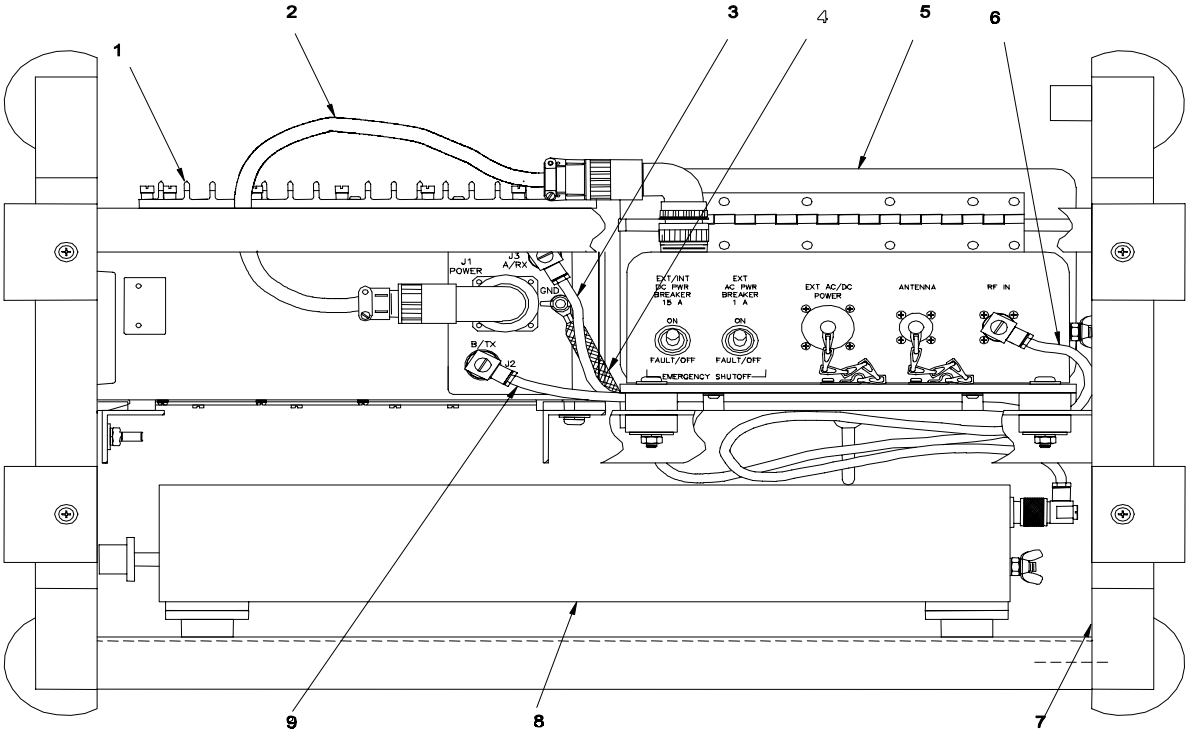


Figure 1-1. Radio Set AN/TRC-207
(Sheet 1 of 3)

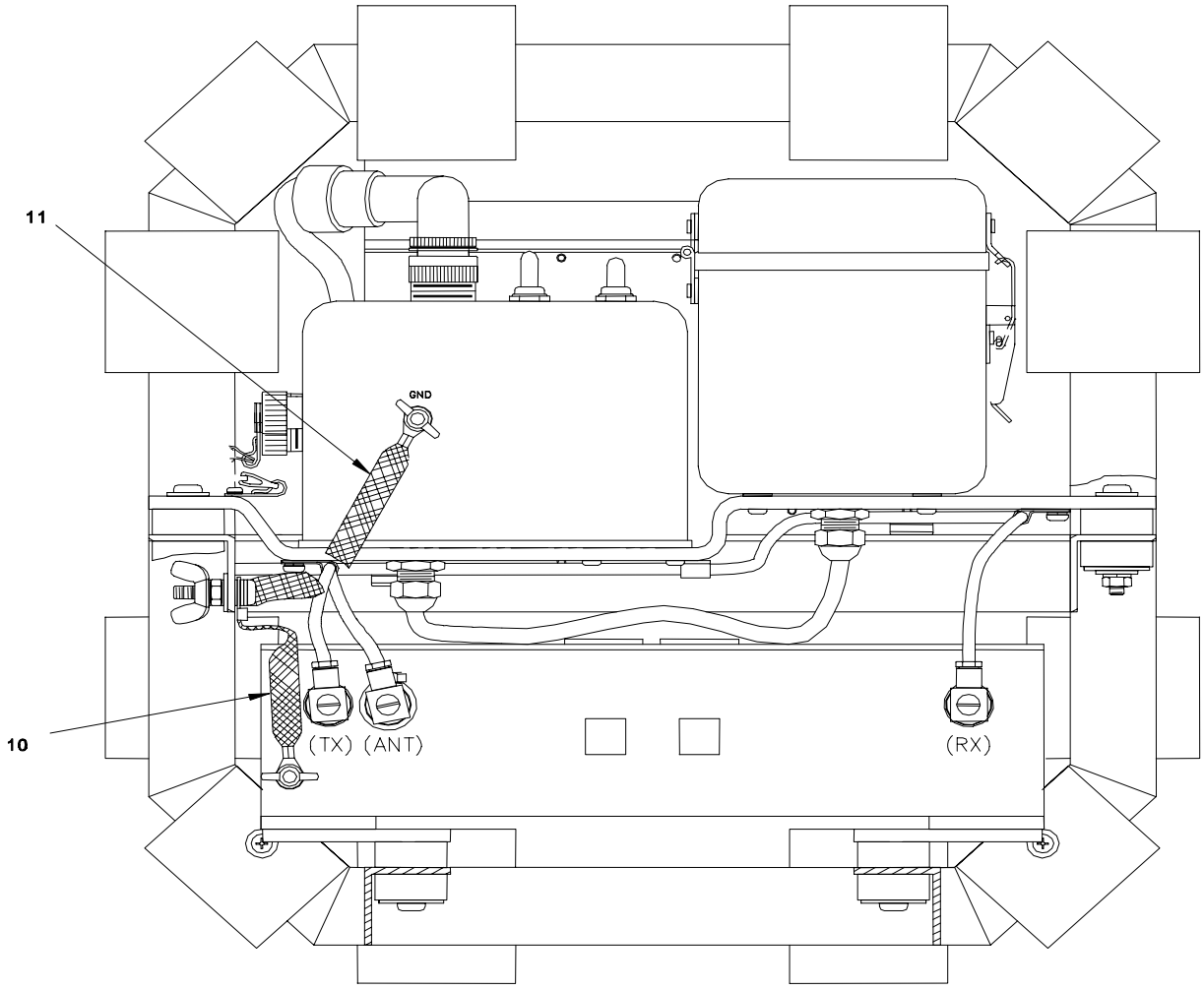


Figure 1-1. Radio Set AN/TRC-207
(Sheet 2 of 3)

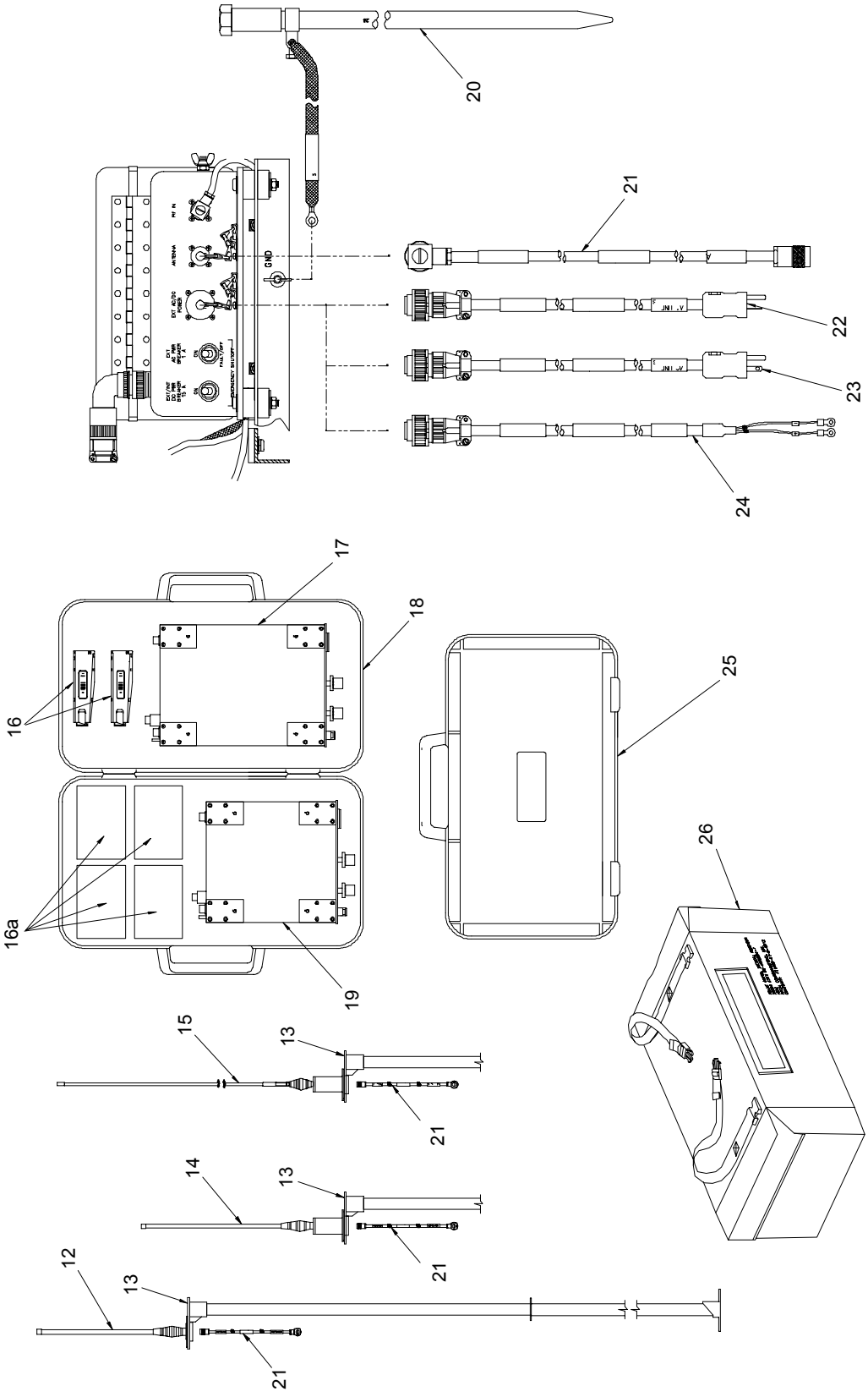


Figure 1-1. Radio Set AN/TRC-207
(Sheet 3 of 3)

CHAPTER 1 GENERAL INFORMATION

1-1 DESCRIPTION AND PURPOSE.

1-1.1 Equipment Function and Purpose

Radio Set AN/TRC-6728 (hereinafter referred to as the bi-directional repeater or BDR) is a communications unit capable of operating in the 30-88, 136-174, or 403-470 Megahertz (MHz) frequency bands. It is used to extend the communications range of fixed, mobile, or portable receiver-transmitters. The BDR is COMSEC (Communications Security) transparent and provides repeater capability for all modes without the need for COMSEC encryption/decryption.

1-1.2 Equipment Description

(See Figure 1-1.) The BDR includes a bi-directional repeater assembly, two non-CCI (Controlled Cryptographic Item) Receiver-Transmitter Sets, Radio RT-1695/TRC-199 (hereinafter referred to as the receiver-transmitters), three antenna systems, an antenna mast, three diplexers, a tubular (weldment) frame, a power supply enclosure, and a battery enclosure.

1-1.2.1 BDR Unit.

(See Figure 7-2.) The BDR unit includes three circuit card assemblies (CCAs) that are accessible through a removable cover on the underside of the unit. These are the +15 volt (V) DC-DC converter CCA (A1), repeater control/audio CCA (A2), and repeater interface (A3). These CCAs plug into the parent board (A4), which interfaces with the control panel assembly (A5), power amplifier assembly (A6), the RF matrix CCA (A7), the external power supply, and the plug-in receiver-transmitters. The receiver-transmitters plug into sleeves (A8, A9) located on the left and right sides of the front panel of the BDR unit. The power amplifier (A6) is mounted under a heatsink on top of the BDR unit.

1-1.2.2 Receiver-Transmitters.

(See Figure 1-2.) The receiver-transmitters provide transmit/receive communication in the 30-88, 136-174, or 403-470 MHz frequency bands. The operating band of the receiver-transmitters is determined by the transceiver module installed. When the transceiver modules are changed, the BDR must be fitted with the proper antenna and diplexer. The proper configurations are listed in Table 1-1.

Table 1-1. BDR Configurations (by Frequency Band)

Frequency Band	Receiver-Transmitter	Antenna	Diplexer
30-88 MHz	SS-4100820-501	4242-MK2-RAC	SS-1600322-501
136-174 MHz	SS-4100821-501	4265-RAC	SS-1600322-502
403-470 MHz	SS-4100822-501	4266-RAC	SS-1600322-503

NOTE

The CCI Receiver-Transmitter RT-1696/U(C) is mechanically different from the RT-1695/TRC-199 to prevent full insertion into the BDR sleeves to avoid the possibility of leaving a CCI radio in an unattended repeater.

1-1.2.3 Antenna Assembly.

The BDR antenna system provides half-duplex transmit and receive capability over one of three bands of operation. The selected antenna is mast mounted. Three antennas are provided to cover the three bands of operation. Refer to Table 1-1. A mast is provided to elevate the selected antenna up to 10 feet (in 5 foot increments) to increase transmission range and quality of transmitted and received signals. The antennas and mast can be installed on a roof or existing tower to further increase range.

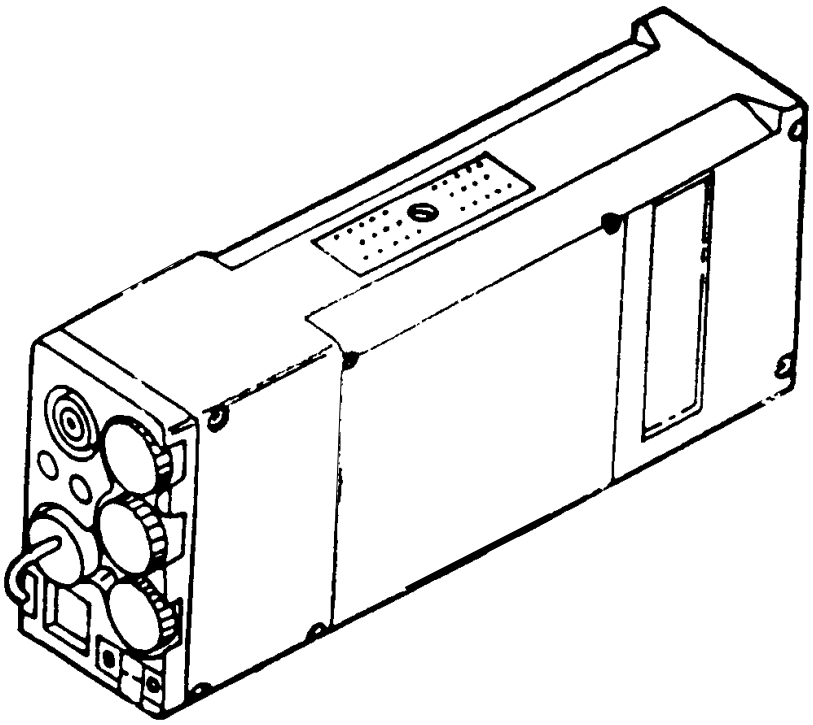


Figure 1-2. Receiver-Transmitter RT-1695/TRC-199

1-1.2.4 Diplexer.

(See Figure 1-3.) The BDR diplexer provides a method of using a receiver and a transmitter on a common antenna. The diplexer has three coaxial connector ports - one port connects to the antenna via the power supply and the other two connect to the Radio A and Radio B ports on the BDR. The diplexer, when properly tuned, provides a transmitter-to-receiver isolation of 70 decibels (dB) at any frequency spacing of 4 MHz or 3% of the operating frequency, whichever is greater. There are three separate diplexers, one for each frequency band. The frequency band of the diplexer must correspond to that of the receiver-transmitter and antenna.

Legend for Figure 1-3
(136-174 MHz and 403-470 MHz diplexers have the same controls, but their appearance is slightly different):

1. Tuning Meter
2. SENS Control
3. RCV Frequency Meter and Tuning Knob
4. XMT Frequency Meter and Tuning Knob
5. TUNE Pushbutton

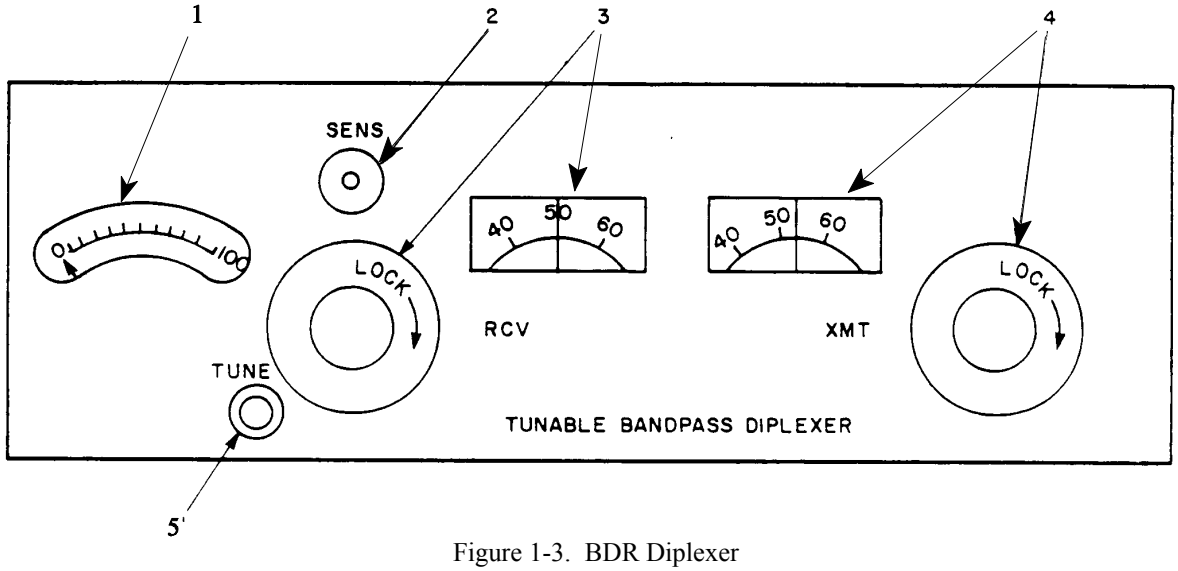


Figure 1-3. BDR Diplexer

1-1.2.5 Power Supply Assembly.

The power supply assembly provides power for the operation of the BDR. The power supply will operate from any direct current (DC) voltage between 10 and 32 volts and from 120/240 or 220 volts alternating current (VAC). The operation of the power supply is controlled by the AC/OFF/DC and internal/external (INT/EXT) DC switches on the power supply. The power supply assembly consists of the power supply enclosure and the battery enclosure, which are mounted on a tray that is bolted to the BDR frame. There are two circuit breakers located on the side of the power supply enclosure that must be in the ON position for BDR operation.

1-1.2.5.1 Power Supply Enclosure.

The power supply enclosure provides the BDR with regulated 28 VDC power and unregulated 15 VDC power. The power supply enclosure includes a +28V DC-DC converter CCA (A2) and circuit breakers for the AC and DC input lines.

1-1.2.5.2 Battery Enclosure.

The battery enclosure is a weather-resistant container that can hold up to four of either Type BA-5590/U Lithium batteries or Type BB-590/U NiCd batteries. The battery connectors are mounted in the bottom of the battery enclosure box. (For battery installation see paragraph 2-10.2.)

1-2 LEADING PARTICULARS

Leading particulars for the BDR are given in Table 1-2.

Table 1-2. Leading Particulars

Characteristic	Parameter
Equipment dimensions and weight (BDR assembly - does not include antennas, antenna cable, or mast):	
Length	28.4 inches (in.) (72.0 centimeters (cm))
Width	18.9 in. (48.0 cm)
Height	18.9 in. (48.0 cm)
Volume	10145 cubic in. (166,247 cubic cm)
Weight (30-88 MHz configuration - BDR unit w/radios, power supply, diplexer, frame)	140.0 pounds (lbs) (63.5 kilograms (kg))
Environmental requirements:	
Temperature:	
Operating	-40° Celsius (C) (-40° Fahrenheit (F)) to +49° C (120°F)
Storage	-51° C (-60° F) to +68° C (155° F)
Humidity	0 to 95 percent relative humidity
Electrical power requirements	10V to 32V DC Battery Power 120/240 " 10% (1 phase, 3 wire) at 50/60 Hertz (Hz) 220 VAC " 10% (1 phase, 3 wire) at 50 Hz
Nominal power consumption	24 VDC Transmit 2W - 2500 mA Transmit 10W - 5000 mA Standby - 500 mA

1-3 CAPABILITIES AND LIMITATIONS

Capabilities and limitations of the BDR are given in Table 1-3.

Table 1-3. Capabilities and Limitations

Characteristic	Parameter
Frequency Range (RCV and XMT)	30-88 MHz 136-174 MHz 403-470 MHz
Transmitter Output	2 and 10 watts selectable
Security	BDR is COMSEC transparent (contains no COMSEC equipment). Equipment will receive and re-transmit analog (nonsecure), 12 kbps (secure), and 16 kbps (secure) FM signals
Interoperability	Radio Set AN/PRC-139/U (C) AN/PRC-77 Manpack Radio Radio Set AN/PRC-128 Radio Set AN/GRC-238 Adapter Group OF-228/U Radio Set AN/TRC-199 SINCGARS-V (single channel) FED-STD-1023 compatible, 12 kbps secure voice VINSON (KY-57) compatible, 16 kbps secure voice Analog 12.5 and 25 kHz frequency modulated (FM) radios
Receiving/Transmitting	25 kilohertz (kHz) Bandwidth on all frequency bands 12.5 kHz Bandwidth on 136-174 MHz and 403-470 MHz bands 12.5 kHz tuning steps
Channels (receive and transmit)	14 channels each programmable with frequency bandwidth, output power, and squelch tones as variables (squelch tones available only in receive)
Adjacent Channel Selectivity	50 dB over 30-88 MHz, 25.0 kHz Bandwidth 52 dB over 136-174 MHz, 12.5 kHz Bandwidth 60 dB over 136-174 MHz, 25.0 kHz Bandwidth 40 dB over 403-470 MHz, 12.5 kHz Bandwidth 48 dB over 403-470 MHz, 25.0 kHz Bandwidth
Sensitivity	Analog (nonsecure) voice: -113 dBm or 0.50μV for 12 dB SINAD. Digital: -105 dBm.
Spurious Response and Image Rejection	65 dB.
Intermodulation Spurious Response	60 dB.

1-4 EQUIPMENT SUPPLIED

Equipment supplied with Radio Set AN/TRC-207 is listed in Table 1-4.

Table 1-4. Equipment Supplied

Official Nomenclature	Part Number	Quantity
BDR Assembly	4101027-501	1
Power Supply Assembly	4101028-501	1
$ Power Supply Enclosure		
$ Battery Enclosure		
Diplexer Assembly, 30-88 MHz	SS-1600322-501	1
Diplexer Assembly, 136-174 MHz	SS-1600322-502	1
Diplexer Assembly, 403-470 MHz	SS-1600322-503	1
Antenna, 30-88 MHz	4242-MK2-RAC	1
Antenna 136-174 MHz	4265-RAC	1
Antenna, 403-470 MHz	4266-RAC	1
Mast, Antenna BDR	SP10SS	1
Case, Transceiver	SS-3100552-501	2
Ground Rod Assembly	SS-3100551-501	1
Receiver/Transmitter Set,		
$ Radio RT-1695/TRC-199	SS-4100807-512	2
$$ System Module, w/o COMSEC	SS-4100819-502	2
$$ Transceiver Module, 30-88 MHz	SS-4100820-501	2
$$ Transceiver Module, 136-174 MHz	SS-4100821-501	2
$$ Transceiver Module, 403-470 MHz	SS-4100822-501	2
Cable Assembly, BDR Power	4500117-501	1
Cable Assembly, Coaxial, RF	SS-3500292-504	1
Cable Assembly, Coaxial, RF	SS-3500292-505	1
Cable Assembly, Coaxial, RF	SS-3500292-503	1
Strap Assembly, Ground	SS-3500279-502	1
Strap Assembly, Ground	SS-3500279-503	1
Strap Assembly, Ground	SS-3500279-504	1
Cable Assembly, Power Supply, 120 VAC Input	SS-4500107-501	1
Cable Assembly, Power Supply, 240 VAC Input	SS-4500108-501	1
Cable Assembly, Power Supply, DC	SS-4500109-501	1
Cable Assembly, Coaxial, Antenna	CPRG223/U-30-XX	1
Bumpers, Tactical repeater Frame	SS-3400353-1	24
Bushing, Shock Mount	SS-2400577-1	8
Clamp, Rear	SS-3100546-501	1
Clamp, Front	SS-3400355-1	1
Frame, Weldment	SS-4400225-1	1
Case, Transit, Diplexer	275-160-100-000	1
Case, Transit, Diplexer	275-160-070-000	1
Cover, Frame	IC-3300RC	1

1-5 EQUIPMENT REQUIRED BUT NOT SUPPLIED

Table 1-5 lists equipment required but not supplied.

Table 1-5. Equipment Required but Not Supplied

Equipment	Part Number
Programmer Unit, Frequency Radio MX-11531/U	SS-4100797-501
Cloning Cable	SS-3500272-501
Antenna Cable (for cross-banding operation)	CPRG223/U-30-XX
Antenna Mast Kit (for cross-banding operation)	SP10SS
Batteries (if internal DC power operation selected)	Lithium Type BA-5590/U or NiCad Type BB-590/U
NiCad Battery Charger/Conditioner (if NiCad BB-590/U batteries used)	MRC-590

1-6 SPECIAL TOOLS AND TEST EQUIPMENT

There are no special tools or test equipment required for maintenance.

1-7 RELATED TECHNICAL MANUALS

Table 1-6 lists related technical manuals.

Table 1-6. Related Technical Manuals

Publication Number	Publication Title
31R2-2PRC139-1	Operation and Maintenance Instructions with Illustrated Parts Breakdown (Organizational Level) for Radio Set AN/PRC-139(C) (includes RT-1695/TRC-199, RT-1696/U (C), Programmer Unit, Frequency, Radio MX-11531/U, Battery Chargers, and Battery Reconditioner)
31R2-2GRC238-1	Operation and Maintenance Instructions with Illustrated Parts Breakdown (Organizational Level) for Radio Set AN/GRC-238
31R2-4-1085-1	Operation and Maintenance Instructions with Illustrated Parts Breakdown (Organizational Level) for Adapter Group OF-228/U
31R2-2TRC207-1	Operation and Maintenance Instructions with Illustrated Parts Breakdown (Organizational Level) for Radio Set AN/TRC-207
31R2-2PRC-139-06	Work Unit Code Manual
35C3-2-113-2	NiCad Battery Reconditioner, MRC-590

CHAPTER 2 INSTALLATION

2-1 INTRODUCTION.

This section is divided into two sections. Section I. Installation Logistics provides information for site preparation, unloading, unpacking, and inspections, housing, receiving data, material handling, cabling, and buildings and other structures. Section II. Installation Procedures lists tools and equipment required for field installation and describes the installation sequence.

Section I. INSTALLATION LOGISTICS

WARNING

Installation of the BDR requires a minimum of two people.

2-2 SITE PREPARATION.

Select an operating site that is free of obstruction and has access to one of the electrical power sources specified in Table 1-2 under Electrical Requirements. The selected operating area must have sufficient room to accommodate the 9583 cubic inch volume of the BDR assembly. The antenna should be at least two antenna lengths (e.g., 44 feet for 30-88 MHz) from power lines and other antennas, etc.

2-3 UNPACKING AND INSPECTIONS.

CAUTION

Exercise care when removing units from packing material in order to prevent damage to the unit.

WARNING

Removing the BDR assembly from the shipping carton requires a minimum of two persons.

To unpack the BDR, remove the unit and any equipment from the carton and store the packing and carton for reuse/shipment. Packing instructions are given in Chapter 3. Inspect contents for completeness, integrity, and damage. Contents shall be in accordance with the packing slips and the list of supplied equipment in Table 1-4.

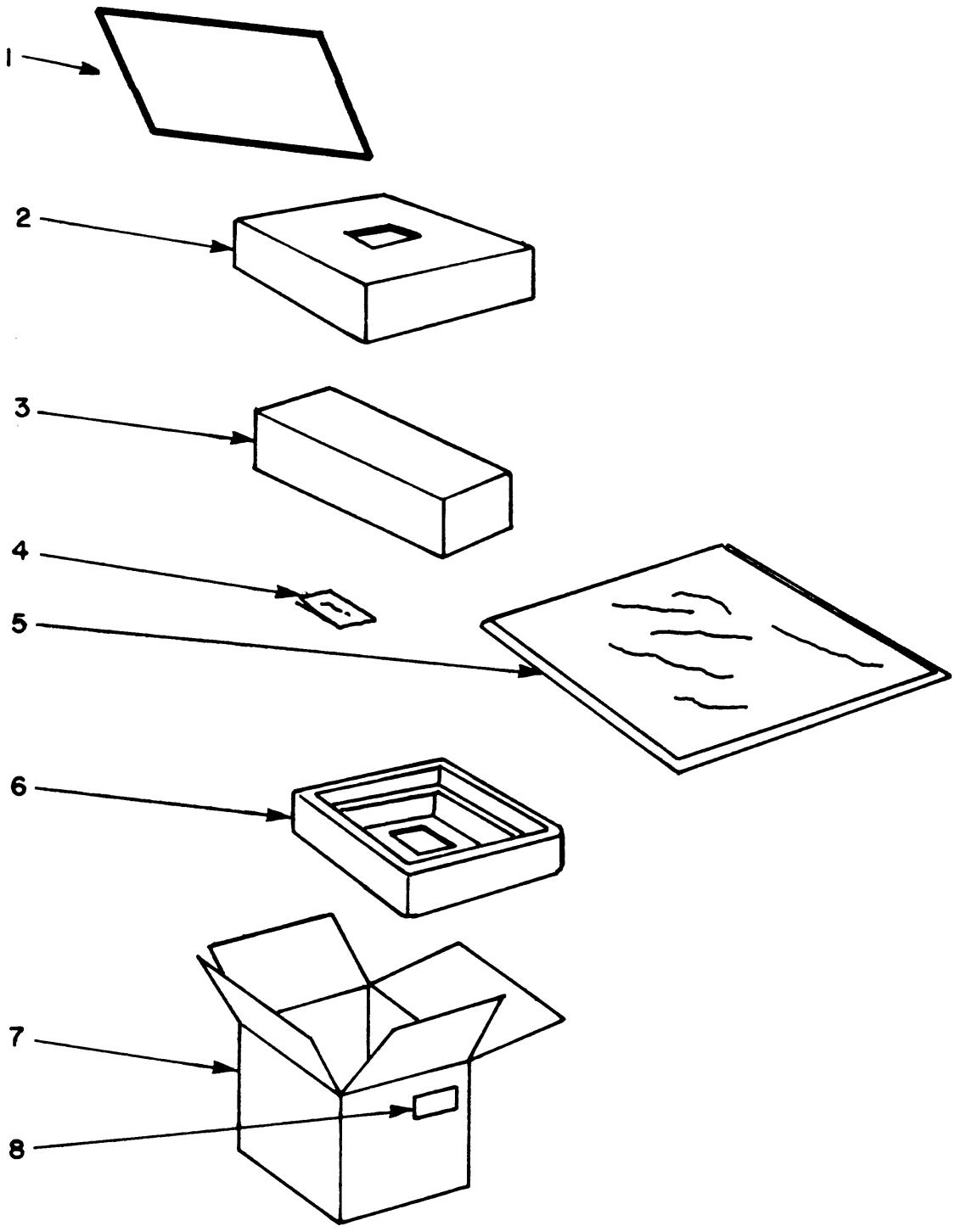
Refer to Figure 2-1 as a guide in performing the following unpacking procedures:

a. Open top of the fiberboard box (7, Figure 2-1) and remove the polystyrene top piece (2) from box.

b. Remove barrier bag (5) from the box.

c. Remove the BDR assembly (3) from barrier bag (5).

d. Remove packing slip (8) from the plastic envelope on the fiberboard box and check to ensure that all items listed on the packing slip were received.



Legend for Figure 2-1

1. Operating instructions
2. Polystyrene top
3. BDR assembly
4. Desiccant bag
5. Barrier bag
6. Polystyrene bottom
7. Fiberboard box
8. Packing slip

Figure 2-1. Packaging Diagram for the BDR

e. Store all packing materials (except the desiccant bag) in shipping container and store shipping container for re-use. New desiccant material must be used when repacking.

f. Inspect top and bottom, both sides, and front and rear panels of equipment for dents, scratches or any visually identifiable damage.

g. Inspect controls and indicators on control panel for missing, broken or cracked knobs or levers and note any discrepancies on Receiving Report, DD Form 1348-1. Report any discrepancies in accordance with standard internal receiving procedures.

2-4 HOUSING.

If necessary to store the BDR for any period of time before installation, proceed as follows:

a. Clean the BDR before placing in storage, if necessary. Refer to paragraph 6-3.3.2.

b. Disconnect antennas and accessories before placing the BDR in storage.

c. Remove receiver-transmitters from the BDR assembly before placing in storage.

d. Remove batteries.

NOTE

The temperature of the storage area must be within the range -51°C (-60°F) to +68°C (155°F).

2-5 RECEIVING DATA.

Table 2-1 identifies the contents of the shipping container.

Table 2-1. BDR Packaging

Box	Description	Dimensions (in)			Weight (lb.)
		W	D	L	
1	BDR	34.625	68	33.75	195

2-6 MATERIAL HANDLING.

The weight of the equipment is such that a minimum of two persons are required to lift the (unpacked) equipment.

2-7 CABLES.

Table 2-2 lists all BDR interconnecting cables.

Table 2-2. BDR Interconnecting Cables

Cable Designation	Cable Part No.	Description	Use
W1	4500117-501	Cable Assembly, BDR Power	Connects power supply DC output to bi-directional repeater
W2	SS-3500292-504	Cable Assembly, Coaxial, RF	Connects diplexer receiver (RX) output to bi-directional repeater assembly
W3	SS-3500292-505	Cable Assembly, Coaxial, RF	Connects diplexer transmitter (TX) output to bi-directional repeater assembly
W4	SS-3500292-503	Cable Assembly, Coaxial, RF	Connects diplexer antenna (ANT) output to RF IN of power supply
W5	SS-3500279-502	Strap Assembly, Ground	Connects bi-directional repeater assembly to external ground
W6	SS-3500279-503	Strap Assembly, Ground	Connects diplexer to external ground
W7	SS-3500279-504	Strap Assembly, Ground	Connects power supply to external ground
W9	SS-4500107-501	Cable Assembly, Power Supply, 120 VAC Input	Connects BDR to 120 VAC
W9	SS-4500108-501	Cable Assembly, Power Supply, 240 VAC Input	Connects BDR to 240 VAC
W9	SS-4500109-501	Cable Assembly, Power Supply, DC	Connects BDR to 10-32 VDC
W10	SS-1600315-1	Cable Assembly, Coaxial, Antenna	Connects antenna to antenna connector of bi-directional repeater power supply

2-8 BUILDING AND OTHER SUPPORTING STRUCTURES

Not Applicable.

Section II. INSTALLATION PROCEDURES

2-9 SPECIAL TOOLS AND EQUIPMENT REQUIRED FOR FIELD INSTALLATION.

No special tools or equipment are needed for installation and initial setup of the BDR.

2-10 INSTALLATION SEQUENCE

(See FO-1.) Perform the following procedure to install the BDR. Cables required for installation are listed in Table 2-2. FO-1 illustrates the required cable connections.

2-10.1 Antenna/Mast Installation

(Refer to Figure 2-2.) Install the antenna mast and selected antenna as follows:

WARNING

Ensure proper use of safety tools (work gloves and hard hat) during assembly and disassembly of antenna and mast.

NOTE

The BDR assembly is shipped from the factory configured for 30-88 MHz operation, with the appropriate receiver-transmitters and diplexer. If using a different configuration, substitute the appropriate antenna, receiver-transmitters, and diplexer. Refer to Chapter 6 for antenna and diplexer removal and replacement. Refer to TO 31R2-2PRC139-1 for changing receiver-transmitter configuration.

NOTE

The assembled antenna base section/antenna adapter will fit in the mast transit bag (3) so that step a may be carried out prior to field deployment, if required. When erecting the antennas in high winds, ensure that a minimum of three personnel are used.

a. Bolt the antenna base section (1, Figure 2-2) to the antenna adapter (2) and connect the antenna ground strap to its terminal.

b. Select an unobstructed site. Under windy conditions mast raising is made easier if the mast is laid out on the ground with the base of the mast pointed into wind.

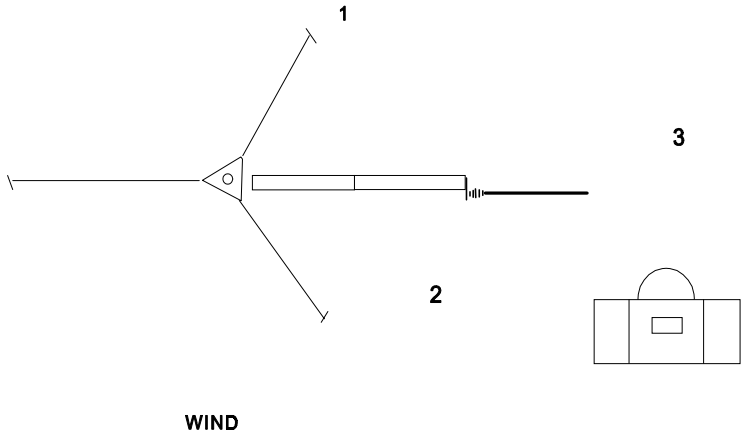


Figure 2-2. Antenna Mast/Antenna Installation (Sheet 1 of 6)

c. Remove both mast sections from the transit bag (3). Note that the socketed end is the lower end of each section. Place the tubes in line along the ground. Assemble the two tube sections together.

d. Remove the base plate (4), two ground spikes (5), and hammer from the transit bag. Place the base plate at the mast base, arrowhead style, so that the socketed lower end of the mast will engage in the heel. Secure the base plate by driving the two ground spikes through the holes.

WARNING

Before using the hammer, ensure a wedge is placed in the top of the hammer so that the hammer head does not come loose, thereby endangering personnel.

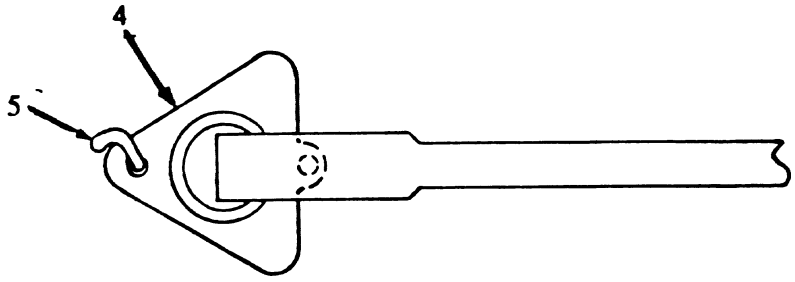


Figure 2-3. Antenna Mast/Antenna Installation (Sheet 2 of 6)

e. Place the antenna/adapter assembly on the top mast section. Ensure the adapter is fully seated on the mast section. Connect the top coaxial cable connector to the antenna and attach cable strain relief to hole in web of adapter. Rest flat edge of adapter on ground to provide convenient access to guy rope attachment points. Unwind cable along length of mast and secure to mast at centers of each section. Secure using cable clamps.

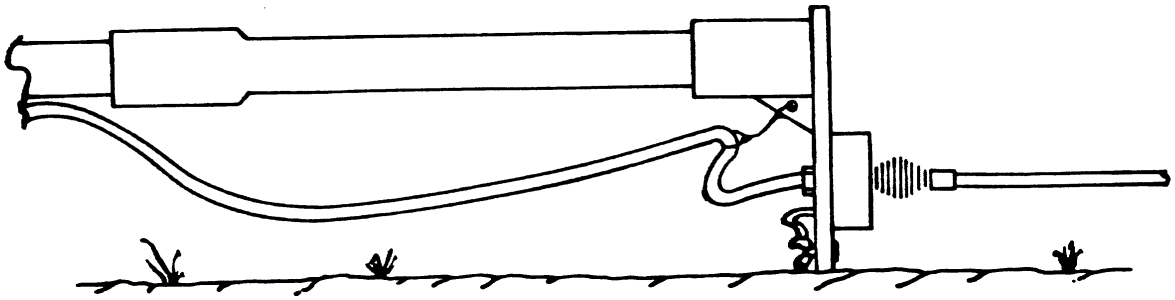


Figure 2-4. Antenna Mast/Antenna Installation (Sheet 3 of 6)

f. Remove three guy rope assemblies (6) and three ground anchors (7) from the transit bag. Disconnect the first (fixed) snap hook off the winder and temporarily connect it to the base plate. Carrying the hammer and one of the ground anchors, walk away in the exact opposite direction to the mast (i.e., in the direction that the arrow head is pointing) unwinding the guy rope as you go, until the ground anchor radius marker is reached. Drive in the ground anchor at this point ensuring that it leans away from the mast (approximately 20^{o} from vertical).

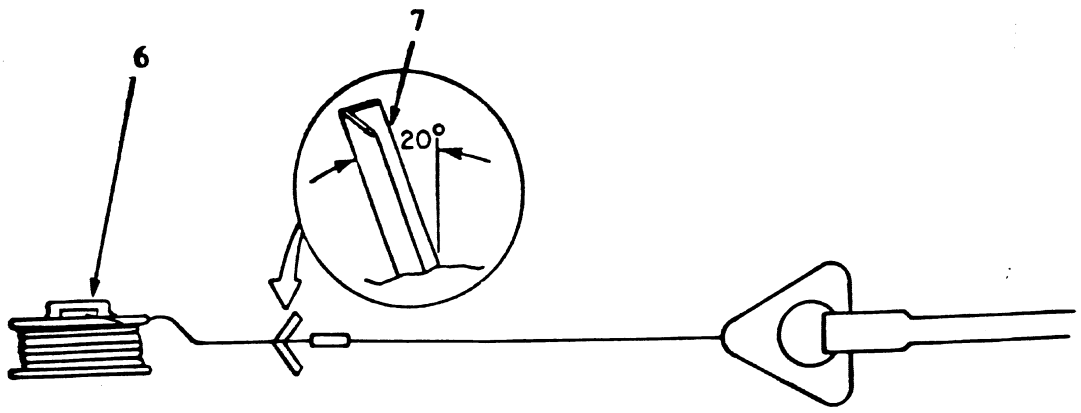


Figure 2-5. Antenna Mast/Antenna Installation (Sheet 4 of 6)

g. Using the same guy rope as a radius guide, walk across to the approximate location of the second ground anchor. Establish the required 120E from the first ground anchor by using the triangular shape of the base plate as a reference. Drive in a second ground anchor at this point.

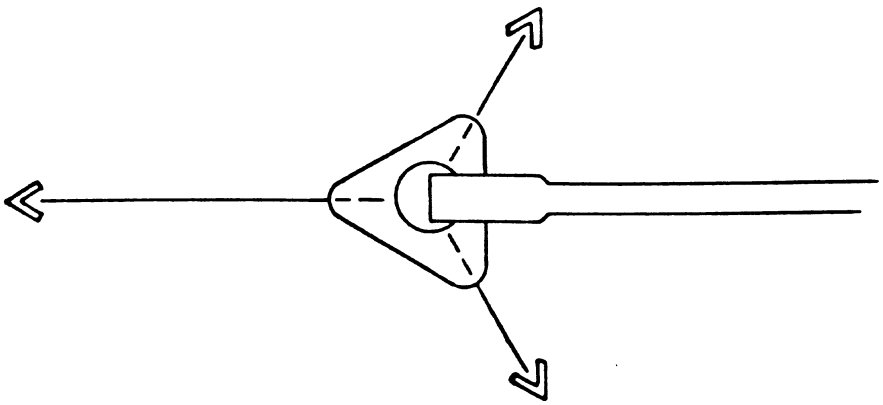


Figure 2-6. Antenna Mast/Antenna Installation (Sheet 5 of 6)

h. Repeat step g for the third ground anchor.

i. Disconnect the guy rope used for a radius marker. Attach the fixed (upper) snap hook to the attachment point on the antenna adapter. Attach the running hook at the lower end to ground anchor 2. Note that the winder remains attached to the lower ends of the guy rope to prevent accidental loss.

j. Take a second guy rope. Attach the fixed (upper) snap hook to the antenna adapter attachment point. Attach the running hook at the lower end to ground anchor 3.

k. Attach the upper snap hook of the third guy rope to the adapter attachment point. Unwind the rope along the length of the mast toward the ground anchor 1, but do not attempt to attach the lower end yet. Ensure that guy ropes will not snag the coaxial cable when the mast is raised.

CAUTION

The adapter and antenna can lift off the mast while the mast is being raised if the adapter is not completely seated on the top mast section.

l. Ensure foot of mast is securely located in the base plate heel. While person A pushes up mast head Iwo Jima style, person B pulls on guy ropes to raise mast to vertical. Person A should progressively walk towards bottom of mast as it is raised and should hold mast steady as it reaches the vertical. Person B attaches free guy ropes to ground anchor 1 and tightens all ropes.

m. Connect the coaxial antenna cable (SS-1600315-1) to the connector at the back of the power supply. Refer to FO-1.

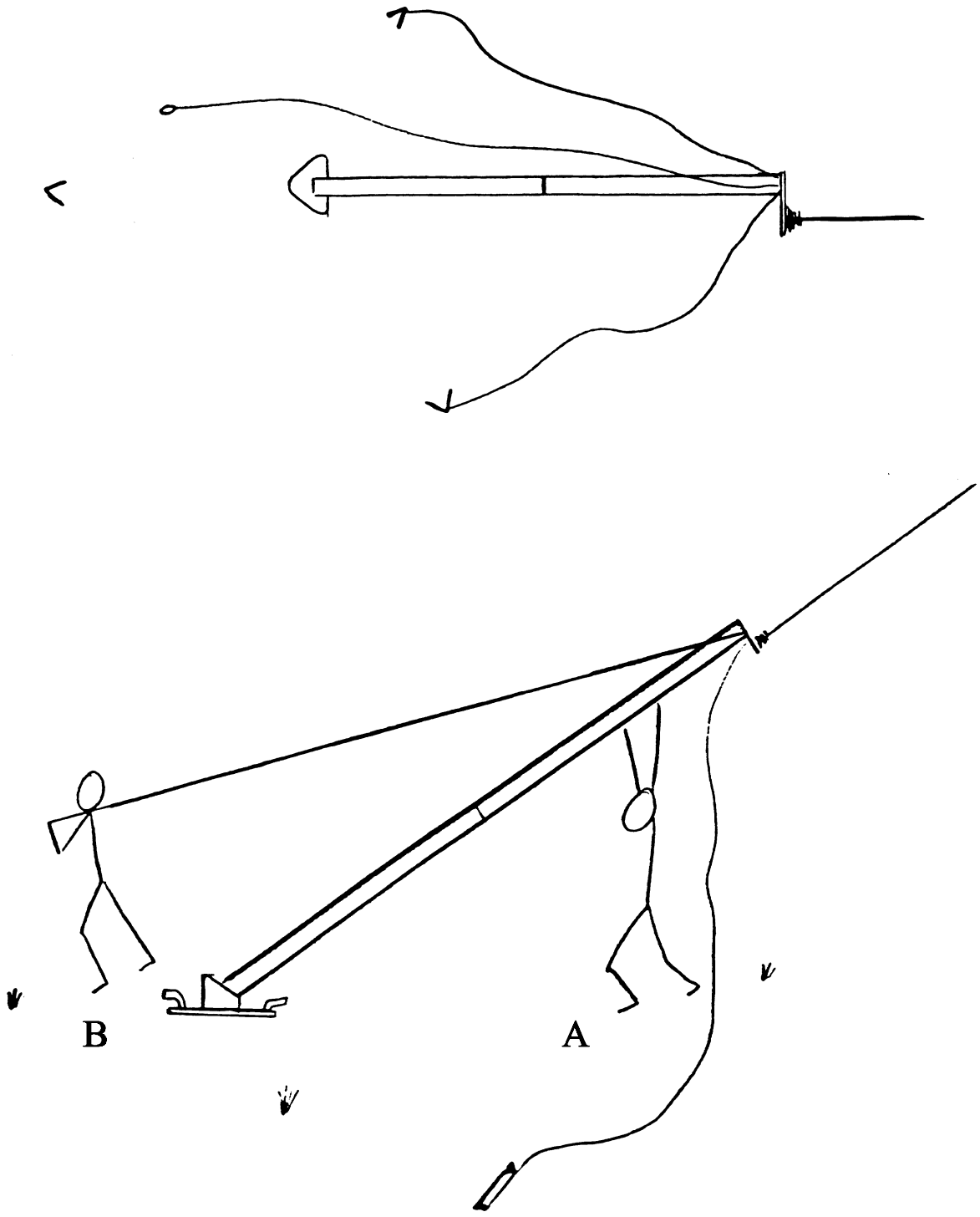


Figure 2-7. Antenna Mast/Antenna Installation (Sheet 6 of 6)

2-10.2 Lithium Battery Installation.

(Optional) (This procedure is also applicable to the Type BB-590/U NiCd batteries.) The battery enclosure has connectors for four type BA-5590/U Lithium batteries. The connectors are mounted in the bottom of the enclosure. To install the batteries, first turn the BDR off using the switch on the top of the power supply enclosure. Open the battery enclosure. Taking each battery, in turn, turn the battery so that the connector is facing down, align the connector on the battery with the connector in the bottom of the enclosure, and push down on the battery until seated.

To power the BDR from the installed batteries, set the power supply POWER switch to DC, and the DC SEL switch to INT. Ensure that both circuit breakers on the side of the power supply are ON. The repeater is capable of full operation with either three or four batteries installed. For battery operation, use of the 2 WATT mode will greatly prolong battery life.

2-10.3 Ground Rod Installation.

The ground rod assembly consists of a 3 foot long ground rod and an attached 10 foot grounding strap. The grounding strap ends in a spade lug that is connected to a ground screw on the BDR assembly frame next to the power supply assembly. (See Figure 1-1 for illustration of grounding strap connection.)

To install, place the BDR in its selected operating location. Locate the ground lug on the frame and select a spot for the ground rod within a 10 foot arc of the ground screw. Drive the ground rod into the ground with a sledge hammer until the grounding strap clamp is level with the ground. Remove the wing nut and washer from the ground screw, place the spade lug over the screw, and reattach the washer and wing nut.

2-10.4 External Power Supply.

To connect the BDR to an external power supply, select the appropriate power supply cable to match the external source (110/220 VAC, 240 VAC, or 10-32 VDC). Connect the power supply cable to the POWER IN connector on the power supply and connect to the power source. Set the power supply POWER switch and DC SEL switch as indicated in Table 2-3.

NOTE

When using external DC power, use as large a DC voltage power source as possible (e.g., a 28 volt battery rather than two 12 volt batteries). The BDR DC power supply operates more efficiently with larger DC voltages.

Table 2-3. External Power Supply Switch Settings

POWER SOURCE	POWER	DC SEL
110/220 VAC	AC	N/A
240 VAC	AC	N/A
10-32 VDC	DC	EXT

2-10.5 Diplexer Installation

Refer to paragraph 6-5.1.6.

2-10.6 Receiver-Transmitter Transceiver Module Installation

Refer to TO 31R2-2PRC139-1.

CHAPTER 3 PREPARATION FOR USE AND RESHIPMENT

3-1 INTRODUCTION.

This chapter is divided into two sections. Section I. Preparation For Use provides post-installation operational checks that must be performed prior to operating the BDR. Section II. Preparation For Reshipment contains procedures for reshipment of the unit.

Section I. PREPARATION FOR USE

3-2 INSPECTION.

If the BDR has not been inspected as part of the installation process, or if the equipment has not been used recently, check to ensure that all cable connections are tight and no damage is visible on the exterior of the BDR.

3-3 POST-INSTALLATION CHECKOUT.

3-3.1 Preliminary

Before performing the post-installation checkout procedures of paragraph 3-3.3, perform the following preliminary procedures.

NOTE

The receive and transmit frequencies programmed into the receiver-transmitters must be separated by at least 4 MHz or 3 percent of the lower frequency, whichever is greater. Similarly, the frequencies on the two nets for bi-directional operation must have similar separations. If the minimum frequency separation is not used, the BDR will not operate properly. See paragraph 4-3 for additional data.

NOTE

For all modes of operation, the receive and transmit frequencies on the channel in use on each radio must be the same (simplex operation).

a. Ensure that both receiver-transmitters (SS-4100807-512) have been programmed with the correct receive and transmit frequencies and CTCSS tones. (TO 31R2-2PRC139-1 describes procedures for programming all programmable parameters.) Use of CTCSS tones is recommended for non-secure operation. ATONES=NONE@ should be used for secure operation.

b. Ensure that the channel select switch on each radio is set to the correct channel, the mode switch is set to CLR, and the SCAN switch is turned off. On/Off/Volume control setting is ignored.

NOTE

Other programmable parameters (RF power, data rate, etc.) may be set to any value.

NOTE

Be sure to align the receiver-transmitters so that the orientation of the control knobs and connectors corresponds to the markings on the sleeve door. The receiver-transmitters cannot be inserted in the bi-directional repeater with the battery attached. The CCI receiver-transmitter (RT-1696/U (C)) cannot be inserted into the BDR.

c. Insert the receiver-transmitter (SS-4100807-512) for the (primary) transmit frequency into the right sleeve (marked "B")of the bi-directional repeater, with the side connector facing up (refer to Figure 1-1). Turn the cam above the receiver-transmitter clockwise until it locks (1/4 turn).

d. Similarly, insert the receiver-transmitter for the (primary) receive frequency into the left sleeve (marked "A") of the bi-directional repeater and lock it into place.

3-3.2 Alignment and Adjustment.

The BDR is aligned and adjusted for normal operation at the factory/depot. No other alignments or adjustments are authorized or required. The diplexer will require retuning as described in paragraph 4-3 whenever the transmit or receive frequencies are changed.

3-3.3 Post-Installation Checkout Procedures

After completion of installation, perform the following checkout procedures.

3-3.3.1 Power-Up Check.

Perform the power-up check as follows:

a. Ensure that both receiver-transmitters are programmed with the proper type squelch settings to receive the desired modulation format (carrier squelch (ATONES=OFF@) or CTCSS tones) (since both are capable of receiving signals).

b. Place the BDR MODE SELECT switch (6, Figure 4-1) in one of the RETRANS mode positions (either BDR or TR operation.)

c. Place the BDR POWER switch (8, Figure 4-1) in the 2WATT or 10WATT position.

d. Place the power supply AC/DC POWER switch (1, Figure 4-2) in either AC or DC position, depending on source of power. If DC is selected, the DC SEL switch must be set for internal (INT) or external (EXT) power source, as appropriate. Ensure that both circuit breakers (1 and 2, Figure 4-3) are switched ON.

e. Ensure that the green POWER LED is illuminated when the DISPLAY switch is ON. This indicates that the unit is receiving power from the power supply.

3-3.3.2 Operational Check.

Perform the operational checkout included in paragraph 6-2 to verify that the major components of the BDR are functioning properly.

3-3.3.3 Equipment Shutdown.

Shut down the BDR as follows:

a. Set the power supply POWER switch to OFF.

b. Ensure that the POWER LED is not illuminated (with the display switch on).

Section II. PREPARATION FOR RESHIPMENT

3-4 PREPARING UNIT FOR RESHIPMENT

Prepare the BDR for reshipment as follows:

a. Disconnect all external accessories, antennas, and cables.

b. Remove the receiver-transmitters prior to shipment.

c. Remove batteries (if installed).

3-5 PACKING.

Pack the BDR in the recommended packages illustrated in Figure 2-1. Use original packing materials if available.

3-6 HANDLING AND STORAGE.

Place electronic assemblies in individual containers. This will prevent damage during handling and storage. If a common container is used, use suitable barrier material between electronic assemblies. Sufficient packing must be used to prevent shifting of electronic assemblies within the container. Package the equipment in accordance with MIL-STD-2073-1A/2B. Marking for reshipment and storage shall be in accordance with MIL-STD-129J.

CAUTION

Never apply pressure sensitive tape directly to connectors. This could damage connector pins.

3-6.1 Protective Measures for Electrical Connectors.

Protect all unmated connectors that are exposed to physical or environmental damage by covering with supplied protective caps.

3-6.2 Preparation for Shipment and Storage.

Before preparing the equipment for shipment or storage, ensure that the receiver-transmitters, batteries, and any other accessories have been removed from the bi-directional repeater.

CAUTION

Package all electrostatic discharge (ESD) sensitive assemblies in ESD bags before shipping or storing.

For shipment to another facility or long-term storage, package the unit as shown in Figure 2-1. Regardless of the electronic assembly design, fit all protruding parts with packing spacers, wrap the complete assembly with plastic or place in a plastic air-lock bag. Wrap with a protective cellulose, foam, or similar material. Wrap assemblies that contain electrostatic discharge sensitive (ESDS) parts in static protective materials.

3-6.3 Handling.

Following are general handling instructions which should be followed when handling the equipment.

WARNING

Before performing removal/replacement procedures, make sure power is removed from the unit by disconnecting from power source. Failure to do so could result in personal injury or equipment damage.

CAUTION

Rough handling may cause unnecessary damage to electronic assemblies.

CAUTION

Electronic assemblies containing solid-state devices are susceptible to damage from static electrical discharges. Wear protective clothing and grounded wrist straps.

CAUTION

Forcing any tilted or cocked electronic assembly into position may result in bent or broken pins.

Be very careful when removing or inserting an assembly into the equipment. If it is a plug-in CCA, be sure the guide pins are properly aligned before pressing the assembly in place. If the CCA tilts while being inserted, do not continue to press into position; straighten it, then apply even pressure to avoid tilting.

CAUTION

When repairing an electronic assembly, be careful that the tool employed does not inadvertently press against leads, pins, or other parts that are easily bent.

CAUTION

Because of the miniaturization of parts for electronic assembly construction, the leads, connectors, and pins have been stiffened to make them more rugged. As a result, such parts are brittle and will break easily if bent too often or pulled on too hard. When handling an assembly that has been removed from its chassis, be careful not to press against the leads and pins. When removing an assembly, be sure to pull it straight out from the equipment. Do not cock, twist, pry, or carelessly jerk an electronic assembly to remove it from the mounting or connector.

CAUTION

ELECTROSTATIC DISCHARGE

The bi-directional repeater contains components that are susceptible to damage by static electrical charges. Disassembly of the bi-directional repeater should only be done at a properly grounded work station.

CHAPTER 4 OPERATION

Section I. CONTROLS AND INDICATORS

4-1 INTRODUCTION

This section describes and illustrates indicators, controls, switches, and connectors of the bi-directional repeater.

4-2 CONTROLS AND INDICATORS.

The following paragraphs describe and illustrate all operational controls and indicators of the bi-directional repeater.

4-2.1 Indicators, Controls, and Switches.

All indicators, controls, and switches for the bi-directional repeater are illustrated in Figure 4-1 and described in Table 4-1.

4-2.2 Power Supply Switches and Connectors.

The bi-directional repeater power switches and top connectors are located on the power supply assembly. The power switches are illustrated in Figure 4-2 and described in Table 4-2.

4-2.3 Connectors.

External side connectors for the power supply are illustrated in Figure 4-3 and described in Table 4-3. External connectors for the repeater unit are illustrated in Figure 4-4 and described in Table 4-4.

4-2.4 Diplexer Control

All diplexer controls for the bi-directional repeater are illustrated in Figure 4-5 and described in Table 4-5.

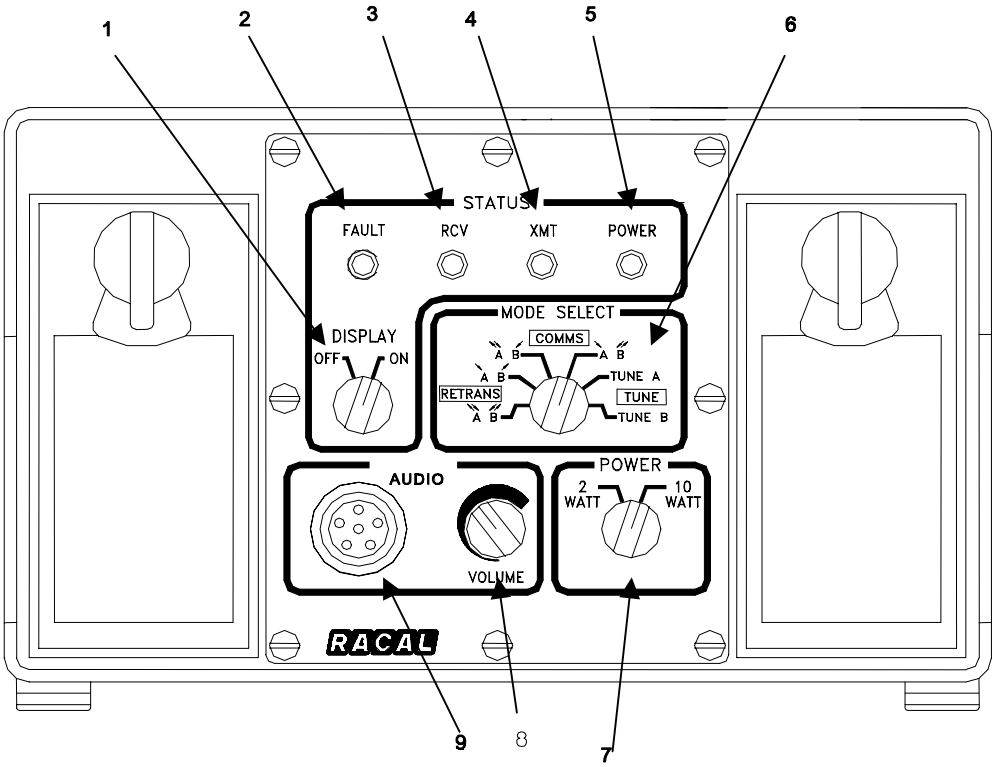


Figure 4-1. Location of Bi-Directional Repeater Indicators, Controls, and Switches

Table 4-1. Description of Indicators, Controls and Switches

Fig & Index Number	Control/Switch	Function
	STATUS:	
4-1-1	DISPLAY Switch (two-position rotary switch)	Controls whether the front panel indicators are operational (ON position) or not operational (OFF position) (The DISPLAY switch should be kept in OFF position to conserve battery life following initial power-up and function check.)
4-1-2	FAULT LED (red)	When illuminated, indicates 1) RF power amplifier internal temperature is excessive (greater than 90E C), 2) RF path fault (diplexer or BDR is cabled incorrectly, diplexer is tuned incorrectly, or frequency spacing is less than recommended minimum), or 3) no or faulty radio in Radio A sleeve.
4-1-3	RCV (Receive) LED (amber)	When illuminated in the RETRANS and COMMS modes, indicates reception of a transmission.
4-1-4	XMT (Transmit) LED (amber)	When illuminated in the RETRANS and COMMS modes, indicates retransmission of a reception. Illuminates also in the TUNE A or TUNE B mode to indicate that the A or B receiver-transmitter is active.
4-1-5	POWER LED (green)	When illuminated, indicates power is applied to the bi-directional repeater.
4-1-6	MODE SELECT Switch (six-position rotary switch)	Allows selection of the bi-directional repeater operating mode as follows: RETRANS - Selects bi-directional repeater (BDR) operation (receive or transmit on either radio) or single direction tactical repeater (TR) operation (receive on one radio, transmit on the other). Unencrypted through traffic can be monitored via local accessory. Local transmit capability is disabled. COMMS - Selects Terminal A or Terminal B modes (broadcast capability through radio A or radio B). Unencrypted traffic reception is available through either radio. Local transmit is available through the selected radio. TUNE A - Allows the "A" receiver-transmitter path of the diplexer to be tuned. All other repeater functions are disabled. TUNE B - Allows the "B" receiver-transmitter path of the diplexer to be tuned. All other repeater functions are disabled.
4-1-7	POWER Select Switch	Selects an output power level of 2 watts or 10 watts.
4-1-8	VOLUME Control	Volume control for attached audio accessory.
4-1-9	Audio Connector	Standard 6-pin connector for audio accessory.

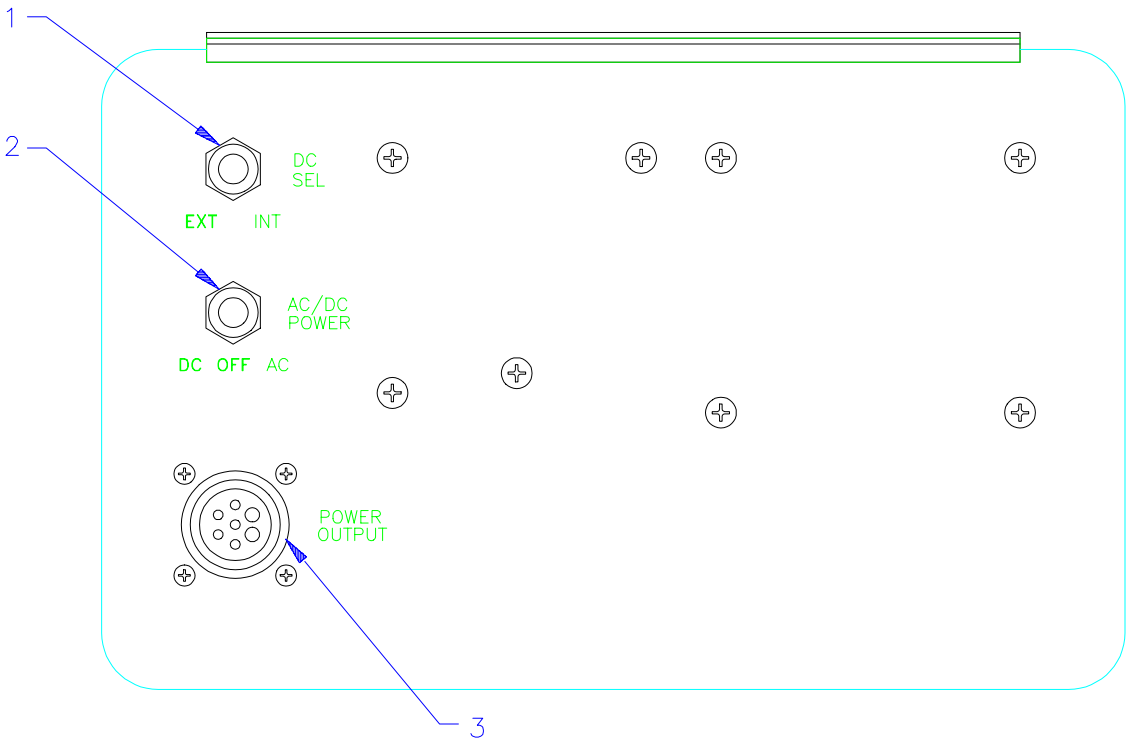


Figure 4-2. Location of Power Supply Switches (Power Supply Top View)

Table 4-2. Description of Power Supply Switches

Fig & Index Number	Switch	Function
4-2-1	DC SEL (INT/EXT) Select switch (two-position toggle switch)	Allows selecting either the internal battery power source or an external DC source when the AC/DC POWER switch is in the DC position.
4-2-2	AC/DC POWER (DC/OFF/ AC) switch (three-position toggle switch)	Allows the operator to turn the bi-directional repeater on and off, and select either an AC or DC power source.
4-2-3	POWER OUTPUT	Connector for power output cable to bi-directional repeater unit

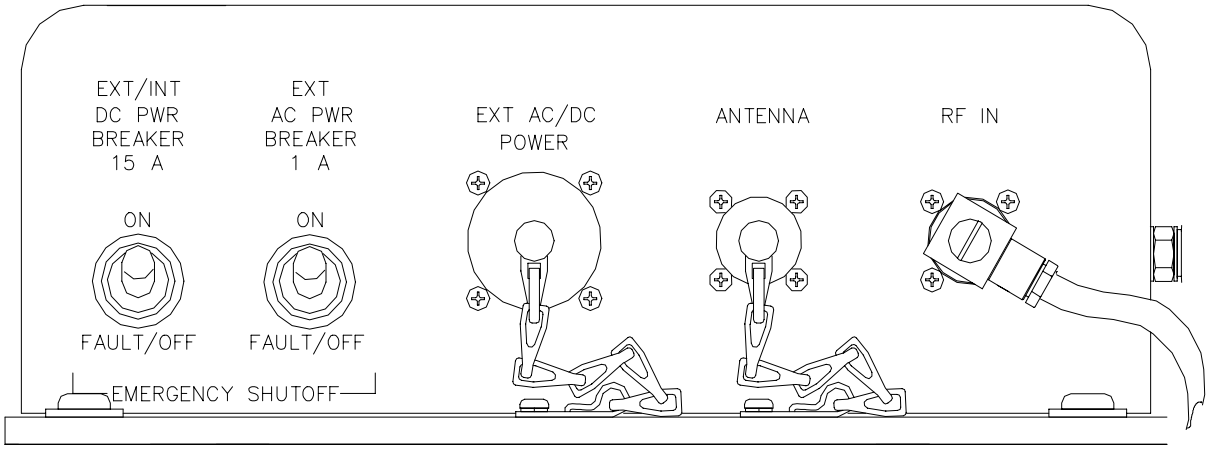


Figure 4-3. Location of Power Supply Connectors (Power Supply Side View)

NOTE
Both the DC and AC Circuit Breakers (4-3-1 and 4-3-2) MUST be switched ON for AC operation

Table 4-3. Description of Power Supply Connectors

Fig & Index Number	Connectors	Function
4-3-1	DC Power Circuit Breaker 15 Amp	In-line circuit breaker for DC power (Input and output)
4-3-2	AC Power Circuit Breaker 1 Amp	In-line circuit breaker for AC input power
4-3-3	External Power Input Connector	External power supply input.
4-3-4	Antenna Out	Coaxial cable to antenna.
4-3-5	RF In	Coaxial cable to diplexer.

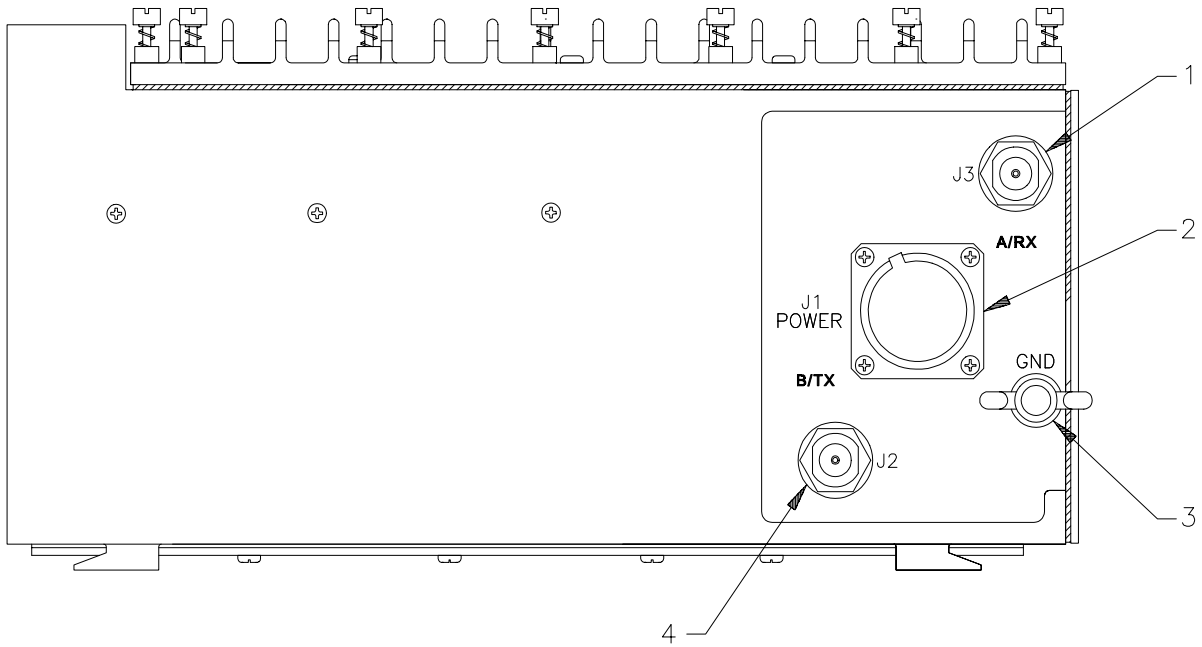


Figure 4-4. Location of Bi-Directional Repeater Unit Connectors

Table 4-4. Description of Repeater Unit Connectors

Fig & Index Number	Connectors	Function
4-4-1	Radio A/RX (Receive) Connector J3	Input from diplexer receive connector to repeater.
4-4-2	POWER Connector J1	Connects repeater to repeater power supply unit.
4-4-3	GND (Ground) Stud	Provides chassis ground point; connects repeater unit to frame system ground.
4-4-4	Radio B/TX (Transmit) Connector J2	Input from diplexer transmit connector to repeater.

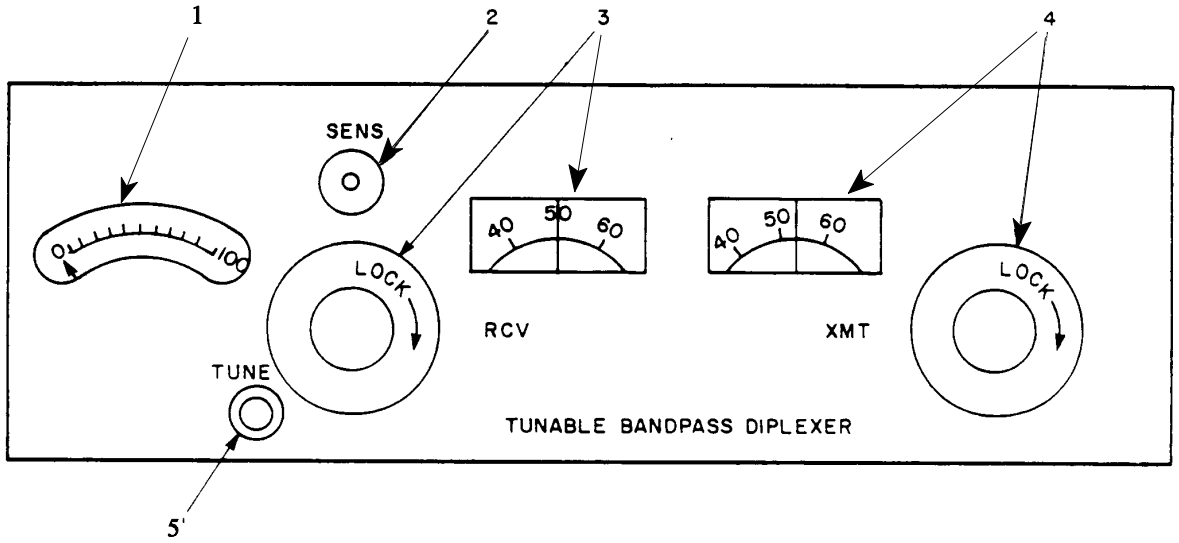


Figure 4-5. Location of Bi-Directional Repeater Diplexer Controls

Table 4-5. Description of Diplexer Controls

Fig & Index Number	Control/Switch	Function
4-5-1	Tuning Meter	Measures relative strength of transmit or receive signals during diplexer tuning.
4-5-2	SENS Control	The SENS control is only active when the TUNE switch is held depressed. The SENS control adjusts the meter sensitivity for tuning purposes. Maximum clockwise position allows the meter to respond to low RF inputs.
4-5-3	RCV (Receive) Control Tuning Knob and Frequency Meter)	The RCV control adjusts the bandpass frequencies of the diplexer for the RX receiver-transmitter (HHR A). Movement of the RCV tuning knob causes the RCV frequency meter movement. The tuning knob has a locking ring to prevent inadvertent movement.
4-5-4	XMT (Transmit) Control (Tuning Knob and Frequency Meter)	The XMT control adjusts the bandpass frequencies of the diplexer for the TX receiver-transmitter (HHR B). Movement of the XMT tuning knob causes the XMT frequency meter movement. The tuning knob has a locking ring to prevent inadvertent movement.
4-5-5	TUNE Switch	When held depressed, allows diplexer meter to respond to RF input from the A or B receiver-transmitter. The TUNE switch is used in conjunction with the SENS control to accomplish tuning.

Section II. OPERATING INSTRUCTIONS

NOTE

Be aware that while performing the initial power-up and diplexer tuning procedures, the bi-directional repeater will radiate RF energy that can cause frequency interference. Do not perform this procedure before the frequency use authorization is obtained and in effect.

4-3 OPERATING MODES AND FREQUENCY RECOMMENDATIONS

This paragraph describes the different modes of operation available with the BDR and provides recommendations for frequency selection to obtain optimum results in each mode.

4-3.1 Operating Modes

There are four different BDR operating modes, described in the following paragraphs.

4-3.1.1 Tactical Repeater Mode.

In this mode, the BDR operates in the same fashion as the basic Tactical Repeater (AN/TRC-199). It can provide one-way extended range linking of one simplex communications net (in which the radios are set to transmit and receive on the same frequency) with another simplex net (see Table 4-6), or limited two-way extended range of a half-duplex net (in which the radios transmit and receive on different frequencies) (see Table 4-7).

4-3.1.2 Standalone Bi-directional Repeater.

One BDR can provide full two-way extended range to a simplex communications net (see Table 4-8). It can be used to link two simplex nets such that they operate as one communications net, even though the radios in the two nets are operating on different frequencies.

4-3.1.3 Tandemed Bi-directional Repeater.

Two or three BDRs can be set up in series (tandemed) to provide two-way communications over a greatly extended range (see Table 4-9). When multiple repeaters are used, user radios may operate on any of the frequencies used in the series (that are within line-of-sight range). For example, users in between two BDRs are able to communicate to users at either or both ends of the chain, depending on the frequency selected.

4-3.1.4 COMMS Mode.

In COMMS mode, the BDR can be used to transmit and receive (unencrypted) radio traffic and to monitor (unencrypted) through traffic on the communications net. This can be done using either Radio A or B.

4-3.2 Frequency Recommendations

General frequency recommendations are shown in the following tables. The basic communications set-up is a Base Station communicating through a BDR to one or more remote handheld radios (HHRs). The frequencies shown in each table (F_1, F_2, F_3) are frequencies within one band that satisfy the separation requirement described below. A critical requirement in determining specific frequencies to be used is that the radio A frequency and the radio B frequency must be separated by at least 4 MHz or 3 percent of the carrier frequency, whichever is greater. Examples of the required separation are:

Frequency A: 30 MHz	Frequency B: at least 34 MHz
Frequency A: 88 MHz	Frequency B: no more than 84 MHz
Frequency A: 136 MHz	Frequency B: at least 140 MHz
Frequency A: 174 MHz	Frequency B: no more than 168.75 MHz
Frequency A: 403 MHz	Frequency B: at least 415.1 MHz
Frequency A: 470 MHz	Frequency B: no more than 455.9 MHz

4-3.2.1 Tactical Repeater Mode.

Table 4-6. TR Simplex Mode Recommended Frequencies
The Mode Select switch should be set to the bi-directional RETRANS position.

MODE	EQUIPMENT	TRANSMIT FREQUENCY	RECEIVE FREQUENCY
Simplex	Base Station	F_1	F_1
Simplex	BDR, Radio A	F_1	F_1
Simplex	BDR, Radio B	F_2	F_2
Simplex	HHR	F_2	F_2

Table 4-7. TR Half-Duplex Mode Recommended Frequencies
The Mode Select switch should be set to the uni-directional RETRANS position.

MODE	EQUIPMENT	TRANSMIT FREQUENCY	RECEIVE FREQUENCY
Half-Duplex	Base Station	F_1	F_2
Half-Duplex	BDR, Radio A	F_1	F_1
Half-Duplex	BDR, Radio B	F_2	F_2
Half-Duplex	HHR	F_1	F_2

4-3.2.2 Standalone Bi-Directional Repeater.

Table 4-8. Single BDR Recommended Frequencies
The Mode Select switch should be set to the bi-directional RETRANS position.

EQUIPMENT	TRANSMIT FREQUENCY	RECEIVE FREQUENCY
Base Station	F_1	F_1
BDR, Radio A	F_1	F_1
BDR, Radio B	F_2	F_2
HHR	F_2	F_2

4-3.2.3 Tandemed Bi-Directional Repeater.

NOTE

HHRs can be programmed with two or more channels to permit the user to access another repeater when one is blocked from view.

Table 4-9. Tandemed BDR Recommended Frequencies
The Mode Select switch should be set to the bi-directional RETRANS position.

EQUIPMENT	TRANSMIT FREQUENCY	RECEIVE FREQUENCY
Base Station	F_1	F_1
HHR Region 1	F_1	F_1
BDR #1, Radio A	F_1	F_1
BDR #1, Radio B	F_2	F_2
HHR Region 2	F_2	F_2
BDR #2, Radio A	F_2	F_2
BDR #2, Radio B	F_3	F_3
HHR Region 3	F_3	F_3
BDR #3, Radio A	F_3	F_3
BDR #3, Radio B	F_4	F_4
HHR Region 4	F_4	F_4

4-3.2.4 COMMS Mode.

Any of the above frequency set-ups can be used in COMMS mode.

4-3.2.5 Operational Techniques.

In addition to frequency separation, there are other considerations that should be made when programming the radios for use:

a. When operating predominantly in the CLEAR mode, use CTCSS tones to reduce unwanted re-transmitting. (Only RX tones are effective in the BDR, not TX tones.)
b. When operating predominantly in the SECURE mode, program the BDR radios for ATONES=OFF@ to speed re-transmission turnaround time.
c. When operating in the SECURE mode, wait approximately 0.5 sec. at the end of a message before replying.

4-3.2.6 Cross-Banding.

The BDR can be used with different frequency bands on Radios A and B (e.g., Radio A in 136-174 MHz band and Radio B in 30-88 MHz band).

4-3.2.6.1 Additional Equipment Requirements.

When using two frequency bands, separate antennas, antenna cables, antenna masts, and diplexers are required for each band used. As noted in Chapter 1, the second antenna mast and antenna cable are not provided with the system. These items can be borrowed from other Scope Shield systems, e.g., Tactical Repeater/BDR or Base Station, or may be purchased separately.

4-3.2.6.2 Set-up.

If the 30-88 MHz band is used, the 30-88 MHz band radio should be inserted in the Radio B sleeve and the B/TX connector (J2) on the BDR unit must be connected to the RF IN connector on the power supply assembly using cable W3. The antenna cable for Radio B is connected to the ANTENNA connector on the power supply assembly and the antenna cable for Radio A is connected directly to the A/RX connector (J3) on the BDR assembly. Figure 4-6 shows the initial (standard) set-up for normal operation. Figure 4-7 shows how the standard set-up is changed for cross-banding operation.

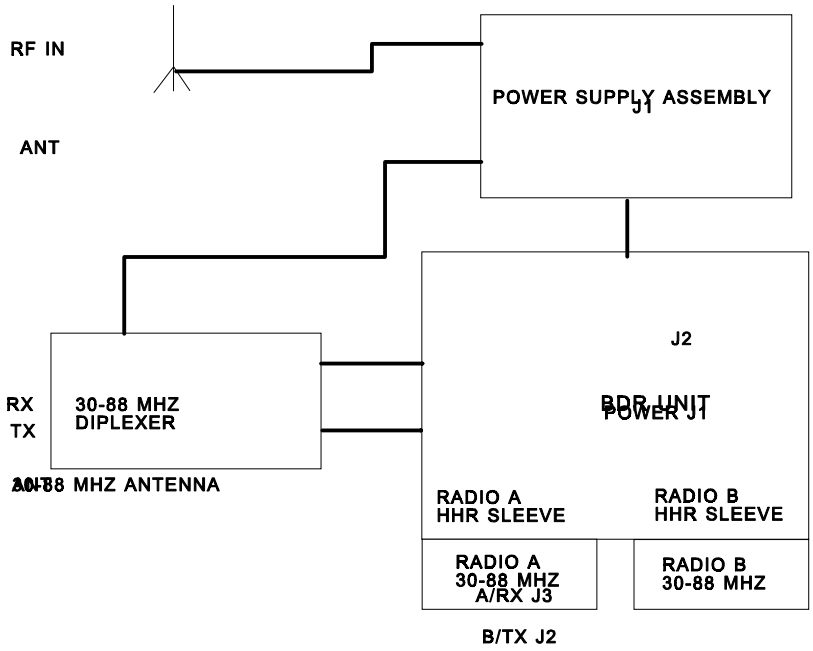


Figure 4-6. Standard BDR Cabling Set-up

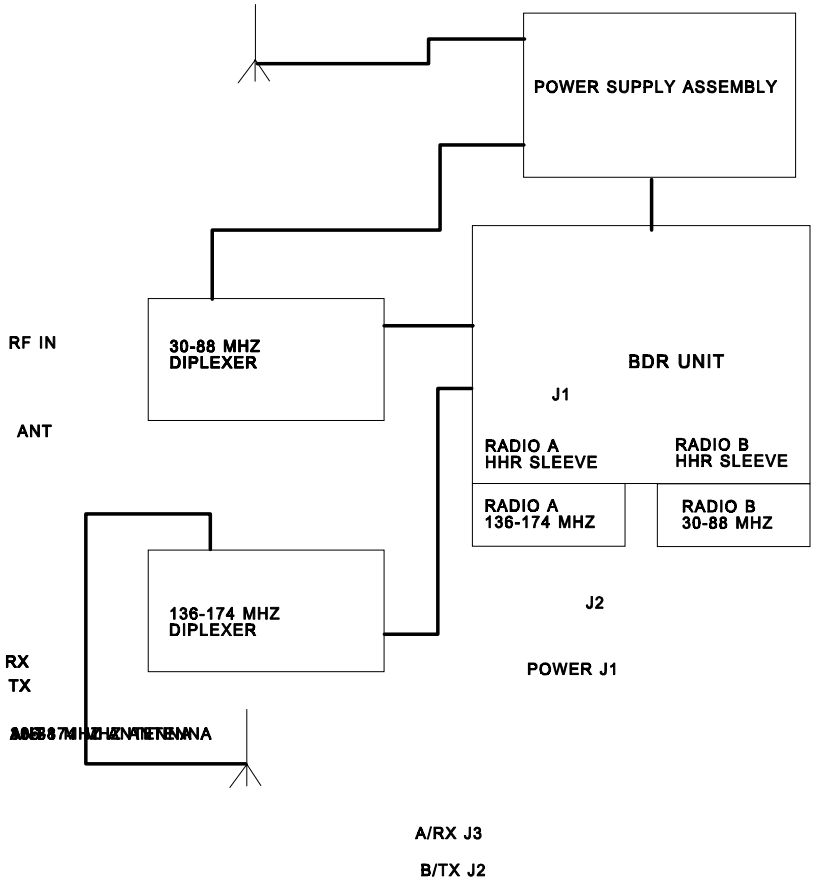


Figure 4-7. BDR Cross-Banding Cabling Set-up

NOTE

The transmit power for RADIO A will always be at peak power regardless of the front panel POWER setting because the routing for RADIO A does not pass through the Power Supply unit, which senses the transmit power and provides gain control back to the power amplifier. Thus, the POWER setting on the front panel only controls the transmit power of RADIO B.

4-3.2.6.3 Precautions for Cross-Banding.

The tripping of circuit breakers and excessive heating could occur if the 30-88 MHz band is not connected as shown in Figure 4-7 , ensuring that the 30-88 MHz band RF path is connected through the Power Supply unit. Avoid using frequencies that are harmonically related, integral multiples of each other, as this could cause the system to lock up by receiving internally generated signals. For example, avoid using combinations such as 76.55 MHz and 153.10 MHz or 150.2 MHz and 450.6 MHz. Do not use the 150 Hz RX and TX tone in this configuration. If RX and TX tones are used the same tone must be used in all radios in both bands. A slight degradation in audio level will occur when the system is configured for cross-banding in the 30-88 MHz band, which could limit the tandem ability in the unencrypted mode. Either side, TX or RX, of the diplexer can be used but the ANT port of the diplexer must be connected to an antenna or the RF IN port of the Power Supply unit. Even though one side of each diplexer is unused, the TX and RX frequency spacing of each diplexer must have the minimum spacing as stated in paragraph 4-3.2. It is important to check that diplexer tuning is adequate by using the TUNE modes (see paragraph 4-4) and to verify proper operation by establishing voice communications using both COMMS modes with radios.

4-4 INITIAL POWER-UP AND DIPLEXER TUNING PROCEDURES

Perform the following procedure to power-up the bi-directional repeater and tune the diplexer.

a. Ensure that the RF cables are properly connected to TX connector J2 (4, Figure 4-4) and RX connector J3 (1, Figure 4-4). Ensure that the proper antenna and diplexer are installed. Ensure that both receiver-transmitters are programmed in a simplex configuration (same receive and transmit frequencies) for each channel being used. It is recommended that CTCSS tones (see TO 31R2-2PRC139-1) be used for repeater operations in the non-secure mode, particularly for tandemed BDRs. All radios in the intended communications net must be programmed with the same tone. Tones should be set to "OFF" for secure operation.

b. Ensure that the bi-directional repeater has been installed as described in Chapter 2. Place the MODE SELECT switch (6, Figure 4-1) in one of the COMMS positions. Place the POWER switch (7, Figure 4-1) in the 2 WATT position. Place the AC/DC POWER switch (2, Figure 4-2) in the DC or AC position, as applicable, and the DISPLAY switch (1, Figure 4-1) in ON position. If DC power is selected, place the DC SEL switch (1, Figure 4-2) in the EXT or INT position, as appropriate. Ensure both circuit breakers are set to ON. Verify that the green POWER LED (5, Figure 4-1) is illuminated.

c. Using the channel select switch on the transmit receiver-transmitter (HHR B), select as the transmit channel the same channel that is being used by the remote receiving receiver-transmitter.

d. Using the channel select switch on the receive receiver-transmitter (HHR A), select as the receive channel the same channel that is being used by the remote transmitting receiver-transmitter.

e. Set the diplexer SENS control (2, Figure 4-5) fully clockwise.

f. Release locking ring on diplexer RCV tuning dial (3, Figure 4-5). Coarse tune the RCV tuning dial (3, Figure 4-5) to the approximate receive channel frequency.

g. Release the locking ring on the XMT tuning dial. Coarse tune the XMT tuning dial (4, Figure 4-5) to the approximate transmit channel frequency.

h. Place the bi-directional repeater MODE SELECT switch (6, Figure 4-1) in the TUNE A position.

i. Adjust the RCV tuning dial (3) with the red TUNE button (1) depressed until a peak meter indication is noticed. If the meter produces 100% deflection, turn SENS control (2) counterclockwise until adjustment of the RCV control yields a peak response less than 100% deflection. Tighten the locking ring on the RCV tuning dial.

j. Set the SENS control fully clockwise.

k. Place the bi-directional repeater MODE SELECT switch (6, Figure 4-1) in the TUNE B position.

l. Adjust the diplexer XMT tuning dial (4, Figure 4-5) with the red TUNE button (5) depressed until a peak meter indication is noticed. If the meter produces 100% deflection, turn the SENS control counterclockwise until adjustment of the XMT control yields a peak response less than 100% deflection. Tighten the locking ring on the XMT tuning dial.

m. Set the MODE SELECT switch to either of the COMMS positions. Establish a communication link with the corresponding remote unit (unit tuned to receive the transmit frequency of each of the COMMS modes). The remote unit should be 20 or more feet away from the BDR (preferably at the expected operational distance). If communication cannot be established, turn the POWER switch to the 10 WATT position and attempt communication again.

n. Set the MODE SELECT switch to the other COMMS position and establish a communication link with the other remote unit.

o. Set the MODE SELECT switch to the single directional (TR) or bi-directional (BDR) mode, as desired.

p. Monitor through traffic via the front panel audio connector, with both remote links set for clear transmission. If the BDR stays keyed constantly, even with no through traffic present, connect a frequency fill device to each radio and reprogram the squelch level to a higher setting. Alternatively, all radios (including the remote links) can be programmed with CTCSS tones.

q. Place the DISPLAY switch (1, Figure 4-1) to the OFF position to conserve battery life.

r. Cover the BDR with the frame cover for concealment and for some protection from the elements.

After the above procedures have been successfully completed, the bi-directional repeater is in an operational mode and can begin to relay radio traffic.

4-5 RECEIVING AND RETRANSMITTING MESSAGES

Whenever the bi-directional repeater is turned on, it is capable of receiving messages and transmitting them (relaying them) back out. Receive and retransmit messages as follows:

a. Perform the initial power-up and diplexer tuning procedure of paragraph 4-3 to turn on the bi-directional repeater and prepare it for operation.

b. Set the POWER switch (6, Figure 4-1) to 2WATT or 10WATT. Turn the DISPLAY switch to ON.

c. Ensure the receiver-transmitters are programmed with the proper type squelch settings to receive the desired modulation format (carrier squelch or CTCSS tones).

d. When a carrier with the proper modulation format is received by the repeater, the RCV LED (3, Figure 4-1) and XMT LED (4) illuminate to verify proper re-transmit operation.

e. If the receiver-transmitter is programmed for carrier squelch and the repeater receives a carrier without CTCSS tones, with CTCSS tones, or with encryption, the RCV LED (3, Figure 4-1) illuminates to verify proper operation. If the receiver-transmitter is programmed for a CTCSS receive tone, the RCV LED (3, Figure 4-1) illuminates only when a carrier with the correct CTCSS tone is received. If an encrypted message is received, the RCV LED (3, Figure 4-1) will illuminate. Encrypted messages will be received and retransmitted even if CTCSS tones are programmed on the receive channel.

4-6 COVERT OPERATIONS

By placing the DISPLAY switch (1, Figure 4-1) in the OFF position, all LEDs on the front panel of the bi-directional repeater are disabled to allow light discipline in blackout conditions. The frame cover is used to further conceal the BDR. Turning off the LEDs also helps to conserve battery power.

4-7 RECEIVER-TRANSMITTERS

For operating procedures for the receiver-transmitters, refer to TO 31R2-2PRC139-1. Ensure that the MODE switch on both radios is set to CLR and the SCAN switch is OFF. Disregard operating procedures for secure mode.

4-8 EQUIPMENT SHUTDOWN

Shut down the bi-directional repeater as follows:

a. Place the AC/DC POWER switch (1, Figure 4-2) in the OFF position.

b. Verify that the BDR is off by confirming that the POWER LED is not illuminated when the DISPLAY switch (1, Figure 4-1) is in the ON position.

c. Emergency shutdown can be accomplished by setting the power supply circuit breakers switches (1 and 2, Figure 4-3) to the FAULT/OFF position.

Section III. EMERGENCY OPERATION

4-9 EMERGENCY POWER

The bi-directional repeater can be powered directly from a battery installed in a vehicle for external power. Use the DC power supply cable assembly (SS-4500109-501) with the positive cable lug connected to the positive battery terminal and the negative cable lug grounded to the vehicle frame.

4-10 ELECTROMAGNETIC PULSE PROTECTION

Electromagnetic Pulse (EMP) is a pulse of broad bandwidth, high amplitude radio frequency electromagnetic energy produced by the radiation from a nuclear burst.

4-10.1 EMP Susceptibility

EMP can deliver a power density to a radio receiver a billion times greater than the power necessary for reception. The voltage and current surges resulting from EMP can overload most modern solid state electronic devices.

4-10.2 EMP Protective Measures

All equipment not absolutely required in primary systems should remain disconnected and stored within a sealed shelter or other shielded enclosure for protection from EMP. At a minimum, equipment not required should be turned off. To prevent or reduce "coupling" with the energy from EMP, wires and cables (to include output coaxial types) should be shielded and properly grounded. Lengths of cables should be kept as short as possible. Excess lengths of cable in use should never be left wound on a cable reel but should be pulled out in a straight line to avoid having loops in the cables. When cables are not needed, they should not be connected to the equipment. Burying cables a foot or more will reduce their exposure to EMP fields. Antennas and their connecting cables should be disconnected from radio sets when not in use. Narrow bandwidth antennas requiring high power for operation reduce the EMP coupling effect.

4-11 NUCLEAR, BIOLOGICAL, AND CHEMICAL (NBC) CONTAMINATION

The Scope Shield equipment has a Chemical Agent Resistant Coating (CARC) finish that reduces the susceptibility to NBC contamination. However, in the event the equipment does become contaminated, great care must be exercised in performing decontamination before the equipment can be returned to use. The power supply must be disconnected to prevent personnel injury and equipment damage. The best way to decontaminate communications equipment is with hot air, although metal surfaces exposed to blister agents and V-agents may be decontaminated with DS2.

WARNING

DS2 is highly corrosive and must be used with extreme care to avoid rendering equipment inoperable.

CHAPTER 5 THEORY OF OPERATION

Section I. FUNCTIONAL SYSTEM(S) OPERATION

5-1 GENERAL

This section describes the theory of operation of the bi-directional repeater. From both technical and operational standpoints, the bi-directional repeater is designed to be a component of a communications system. It must function in conjunction with other system components (receiver-transmitters, base stations, and vehicle adapters) to perform communication functions. However, it does not depend on other receiver-transmitters for its proper functioning or performance. The bi-directional repeater operates in the 30-88, 136-174, and 403-470 MHz frequency bands, retransmitting analog frequency modulation (FM), or 12 kbps or 16 kbps Continuously Variable Slope Delta Modulation (CVSD) digitized voice. The transmitter output consists of a single channel frequency-modulated carrier. The transmitter power output as measured at the antenna port is selectable at 2 or 10 watts. The bi-directional repeater is COMSEC transparent and does not have internal COMSEC components. It can pass both encrypted and unencrypted traffic. The bi-directional repeater provides extension of the communication range for base stations and receiver-transmitters by providing a bi-directional receive/retransmit capability without the need to decrypt/encrypt the transmission. It is intended to operate as a self-contained/stand-alone unit in an unprotected environment.

5-2 FUNCTIONAL SYSTEM(S) OPERATION

(See Figure 5-1.) Paragraphs 5-2.1 through 5-2.11 provide a limited system description of the bi-directional repeater. The functional block diagram (Figure 5-1) shows the interrelationship between the main circuits of the bi-directional repeater.

5-2.1 +15V DC-DC Converter Circuit Card Assembly (CCA) (A1A1)

The +15V DC-DC converter CCA (A1A1) provides regulated +15 VDC to the repeater control CCA (A3) and both hand-held receiver-transmitters. The DC-DC converter operates from a 10-32 VDC input.

5-2.2 Repeater Control/Audio Circuit Card Assembly (CCA) (A1A2)

The repeater control/audio CCA (A1A2) combines the signal control and the audio interface between the two receiver-transmitters and provides the audio output and microphone input. The audio out function is active in both COMMS and RETRANS modes; the microphone in (MIC IN) function is active only in COMMS mode. The assembly provides reclocking of data when data format is received by the receive receiver-transmitter. It also automatically identifies whether a 12 kbps or 16 kbps signal is received. This CCA contains timing circuits to control the push-to-talk (PTT) line of the transmit receiver-transmitter. Timing circuitry is included to reduce the possibility of missing the initial data bits. Received audio is routed to the microphone line of the transmit receiver-transmitter and the SQ/CTS, signal present line of the receive receiver-transmitter is converted to the PTT line of the transmit receiver-transmitter. The repeater control CCA passes both clear and encrypted signals.

5-2.3 Repeater Interface CCA (A1A3)

The Repeater Interface card contains no electronic components. Its purpose is to link certain parent board tracks to control board tracks. The linked functions are the audio line, the microphone line, and some front panel control lines.

5-2.4 Parent Board Circuit Card Assembly (CCA) (A1A4)

This card provides the interconnection between the other circuit card assemblies and provides power to the receiver-transmitters.

5-2.5 Control Panel (A1A5)

The control panel (A1A5) contains all operator controls and indicators. This card contains the power amplifier Automatic Level Control (ALC) adjustments for both output power settings. The audio amplifier, microphone pre-amplifier, and voltage regulator circuits on this card enable local operations.

5-2.6 RF Power Amplifier Assembly (A1A6)

The RF power amplifier (A1A6) amplifies the output of the transmit receiver-transmitter to 2 or 10 watts, measured at the output of the diplexer, as determined by the setting of the POWER switch.

The amplifier can function over the entire frequency range of 30-470 MHz, with transceiver operation only in the 30-88, 136-174, and 403-470 MHz frequency bands.

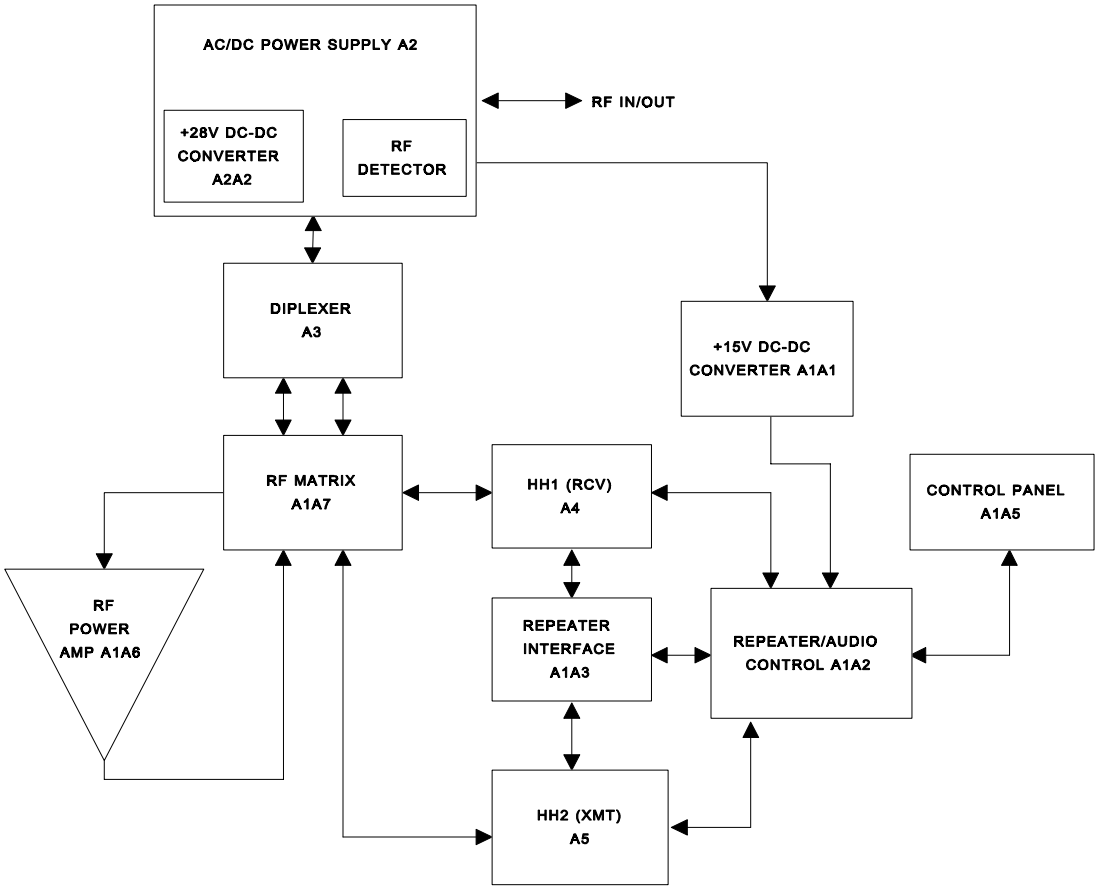


Figure 5-1. Bi-directional Repeater System, Functional Block Diagram

5-2.7 RF Matrix CCA (A1A7)

The RF Matrix CCA (A1A7) provides the mechanism by which the BDR can either receive or transmit through either one of the installed receiver-transmitters. When one receiver-transmitter lifts squelch (receives a valid voice or data signal), the other radio is switched into the power amplifier (PA) and the PA output is switched to the corresponding diplexer port. This card also contains the RF fault detection circuitry, which detects anomalies by monitoring the antenna line of each receiver-transmitter.

5-2.8 Receiver-Transmitters

Two receiver-transmitters are used in the bi-directional repeater. The type of receiver-transmitter used in the bi-directional repeater is a transceiver (combination transmitter and receiver) capable of operating in the 30-88, 136-174, or 403-470 MHz frequency bands. The receiver-transmitter used within the bi-directional repeater (RT-1695/TRC-199) differs from the standard receiver-transmitter (RT-1696/U/(C)) only in that the repeater version does not have encryption/decryption capability. The bi-directional repeater is COMSEC transparent and does not need to decrypt encrypted traffic prior to relaying it back out over the transmit frequency.

Refer to TO 31R2-2PRC139-1 for additional information on the receiver-transmitter. TO 31R2-2PRC139-1 covers both the RT-1695/TRC-199 and RT-1696/U(C) receiver-transmitters. Both receiver-transmitters are identical except the RT-1696/U(C) is fitted with an INDICTOR COMSEC encryption/decryption integrated circuit and is designated a Controlled Cryptographic Item (CCI). The RT-1696/U(C) receiver-transmitter, which is part of the AN/PRC-139(C) and AN/GRC-238, shall not be used in the bi-directional repeater and cannot be physically inserted into the BDR sleeves. The RT-1695/TRC-199 and RT-1696/U(C) receiver-transmitters have different notches on the chassis base (part of the battery connector) that mate with matching notches in the different units in which they are installed. This prevents inadvertent installation of the RT-1696/U(C) in the bi-directional repeater.

5-2.9 Antenna System

The antenna for the bi-directional repeater provides simultaneous transmit and receive capability. The antenna provides transmit and receive frequency coverage over one of each of the bands of operation. Three antennas cover all of the frequency bands of operation: 30-88 MHz, 136-174 MHz, and 403-470 MHz.

The antenna provides an average gain in each band as indicated in Table 5-1.

Table 5-1. Antenna System Frequency Band Vs Gain

Frequency Band	Gain
30-88 MHz	-7 dBi to +2 dBi
136-174 MHz	+2.5 dBi or greater
403-470 MHz	+2.5 dBi or greater

5-2.10 Diplexer (A3)

The diplexer provides a method of using both a receiver and a transmitter on a common antenna. The diplexer, when properly tuned, provides a transmitter to receiver isolation of 70 dB at any frequency spacing of 4 MHz or 3% of the operating frequency, whichever is greater. The diplexer has an insertion loss of less than 2.25 dB between the transmit port and the antenna, and less than 3.0 dB between the receive port and the antenna. The diplexer is capable of handling 60 watts of RF power in the transmit path and provides protection at the receive port to limit receive signals to a maximum level of +33 dBm (for dBi, dBm, see Glossary).

5-2.11 AC/DC Power Supply (A2)

The AC/DC power supply enables the bi-directional repeater system to operate from the following power sources:

a. External 115V 50/60 Hz AC
b. External 230V 50/60 Hz AC
c. External 10V to 32V DC
d. Internal battery power: one to four self-contained replaceable batteries can be used; use of at least three is recommended; type BA5590/U Lithium or BB590 nickel-cadmium. For battery operation, use of the 2 WATT mode will greatly prolong battery life.

All external power sources are accessed through a common connector on the power supply assembly. A unique cable is provided to accommodate each source. Two toggle switches operate as described in Table 4-2.

The power supply enclosure contains an RF peak detector that produces a DC voltage that is proportional to the transmitted RF power. The detector is used with the repeater unit as part of the RF output power automatic level control (ALC).

The power supply enclosure also contains a +28V DC-DC Converter CCA. The +28V DC-DC converter (A2A2) provides regulated +28 VDC to the RF power amplifier (A1A6). The power converter operates from a 10-32 VDC input.

Section II. FUNCTIONAL OPERATION OF ELECTRONIC CIRCUITS

5-3 REPEATER CONTROL/AUDIO CIRCUIT CARD ASSEMBLY (CCA) (A1A2)

As shown in Figure 5-2, the repeater control/audio CCA (A1A2) consists of the following major functions:

a. Multiple inputs - The control CCA can accept clear (analog) voice or digital data input from either Radio A or Radio B, or clear voice input from the local audio connector (MIC) on the front panel. The local MIC input will only be active if the BDR mode switch is set to one of the COMMS positions.
b. Clear path - The clear signal path provides amplification and filtering of the analog voice signals received by the BDR and converts the analog to digital signals that can be used by the digital signal processor (DSP).

c. Data path - The data path is made up of two slicer circuits (one for each radio) and a Field Programmable Gate Array (FPGA). The purpose of the slicer circuits is to interpret the digital data contained in the analog radio frequency (RF) signals by monitoring the positive and negative signal peaks. The FPGA sends interrupts to the DSP when digital data is received and transfers the digital data to the DSP.

d. Digital signal processor (DSP) - The DSP is the brain of the control CCA. Whenever the BDR is powered up, or the position of the mode switch is changed, the DSP checks the identity (frequency band) of the radio in the Radio A sleeve, and adjusts the gain control to match the frequency band found. It continuously monitors the radio squelch line to determine when either radio begins receiving incoming traffic. When squelch is lifted (signal received) on either radio, the DSP recognizes which radio is receiving and signals the RF matrix CCA (A1A7) switches to route the transmit radio signal through the RF amplifier. Encrypted traffic does not use CTCSS tones and will not lift squelch on a radio programmed for CTCSS tones. To ensure that encrypted traffic is re-transmitted, the DSP monitors the input from the data path. Even if squelch is not lifted, when a valid 12 or 16 kbps data signal is received from the FPGA, the DSP recognizes which radio is receiving the data traffic and signals the RF matrix CCA switches to route the transmit radio signal through the RF amplifier. When the front panel mode switch is set to one of the COMMS positions, the DSP monitors the local Push-to-Talk (PTT) line. When the PTT is keyed, the DSP recognizes which radio has been selected as the transmit radio and sets the RF matrix CCA switches to route the transmit radio output through the RF amplifier.

e. Combined clear/data output path - All output from the DSP, whether voice or data, follows the same path. The digital output is converted from digital to analog. The analog signal is then amplified and sent on all three available routes: radio A, radio B, and local audio (front panel audio connector). The transmit circuits in the receiving radio are not active, so only the transmit radio will generate an RF output. The local audio signal makes it possible to monitor all (unencrypted) through traffic.

5-4 15 WATT POWER AMPLIFIER ASSEMBLY (A1A6)

(See Figure 5-3.)As shown in Figure 5-3, the 15 watt power amplifier assembly (A1A6) consists of the following major functions:

a. RF signal path and AMPKEY control - The RF signal path varies depending on whether the amplifier is keyed on or not. When the amplifier is not keyed, diode CR7 is turned off and diode CR8 is turned on. The received RF signal at J3 bypasses the power amplifier. When the amplifier is keyed, the input signal at J2 is amplified through the RF power transistors Q1 and Q2 and transmitted.

b. Automatic level control (ALC) and RF detector (RF DET) - The ALC is used to reduce the RF output power. Part of the ALC loop is the RF detector (RF DET), which monitors the transmitted RF signal level. The ALC circuitry controls the power amplifier gain by varying the bias voltages of Q1 and Q2 in response to the RF DET voltage. This is done to maintain a flat RF output power response across the frequency bands.

c. Manual level control MLC) - The MLC is used to manually control the gain of the power amplifier. It is set during power amplifier calibration at the factory and does not require further adjustment.

d. Thermal protection (PATEMP) - The PATEMP circuit protects against thermal damage caused by the power dissipated in Q1 and Q2. When the unit temperature reaches 90EC, the amplifier gain is reduced.

e. Current limiting - The power amplifier is protected against damage caused by drawing high DC current. R29 senses the drain current to Q1 and Q2. When the drain current reaches a preset level, the bias voltage of Q1 and Q2 is reduced.

f. EEPROM - The EEPROM stores temperature-related calibration data which is used to adjust output power levels by controlling the input ALC voltage.

g. Voltage regulators - Three voltage regulators are used to provide +5.2V(U3), +12V(U4), and +18V(U5) to the control circuits in the power amplifier.

Section III. FUNCTIONAL OPERATION OF MECHANICAL ASSEMBLIES

Not Applicable.

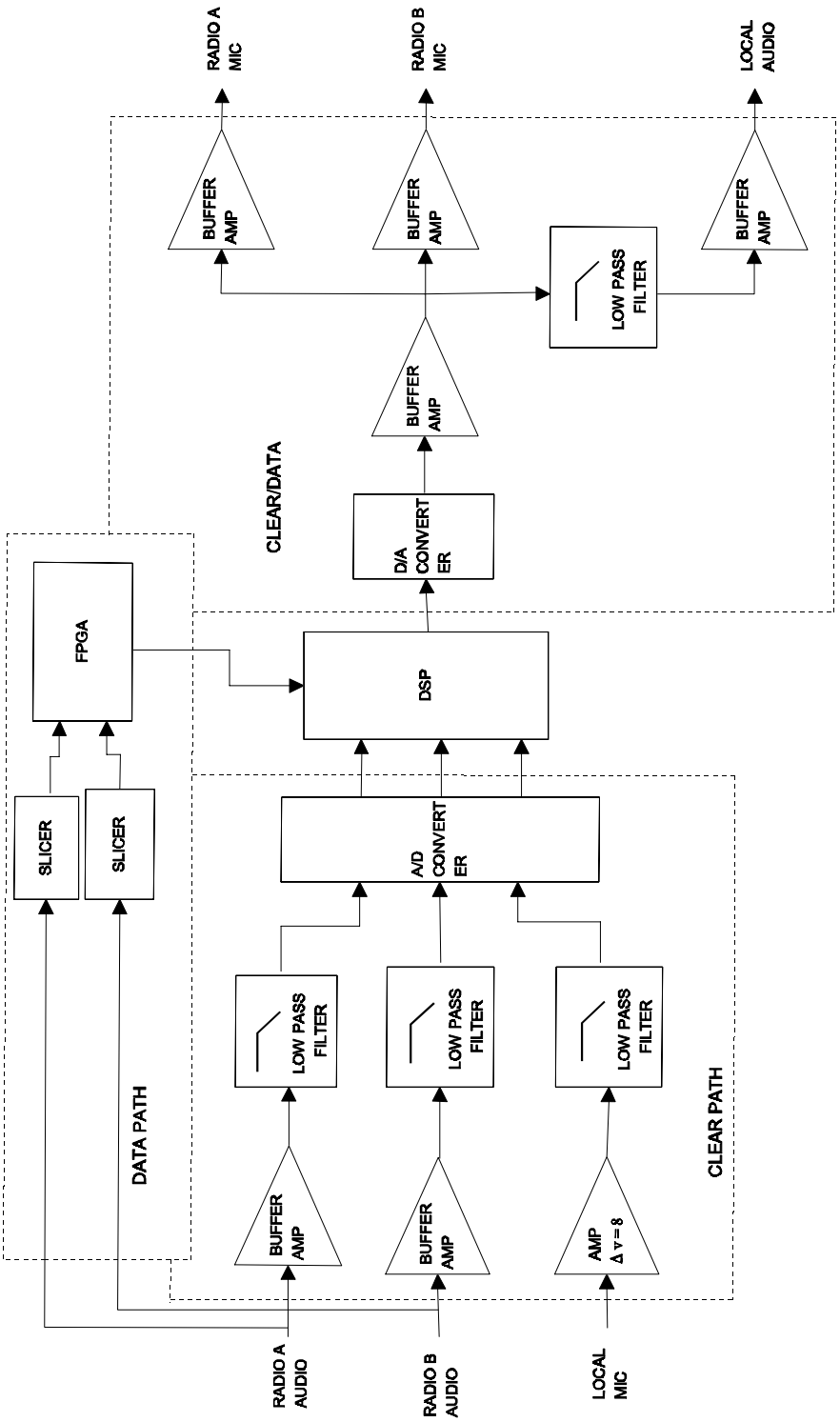


Figure 5-2. Repeater Control/Audio CCA (A1A2), Functional Block Diagram

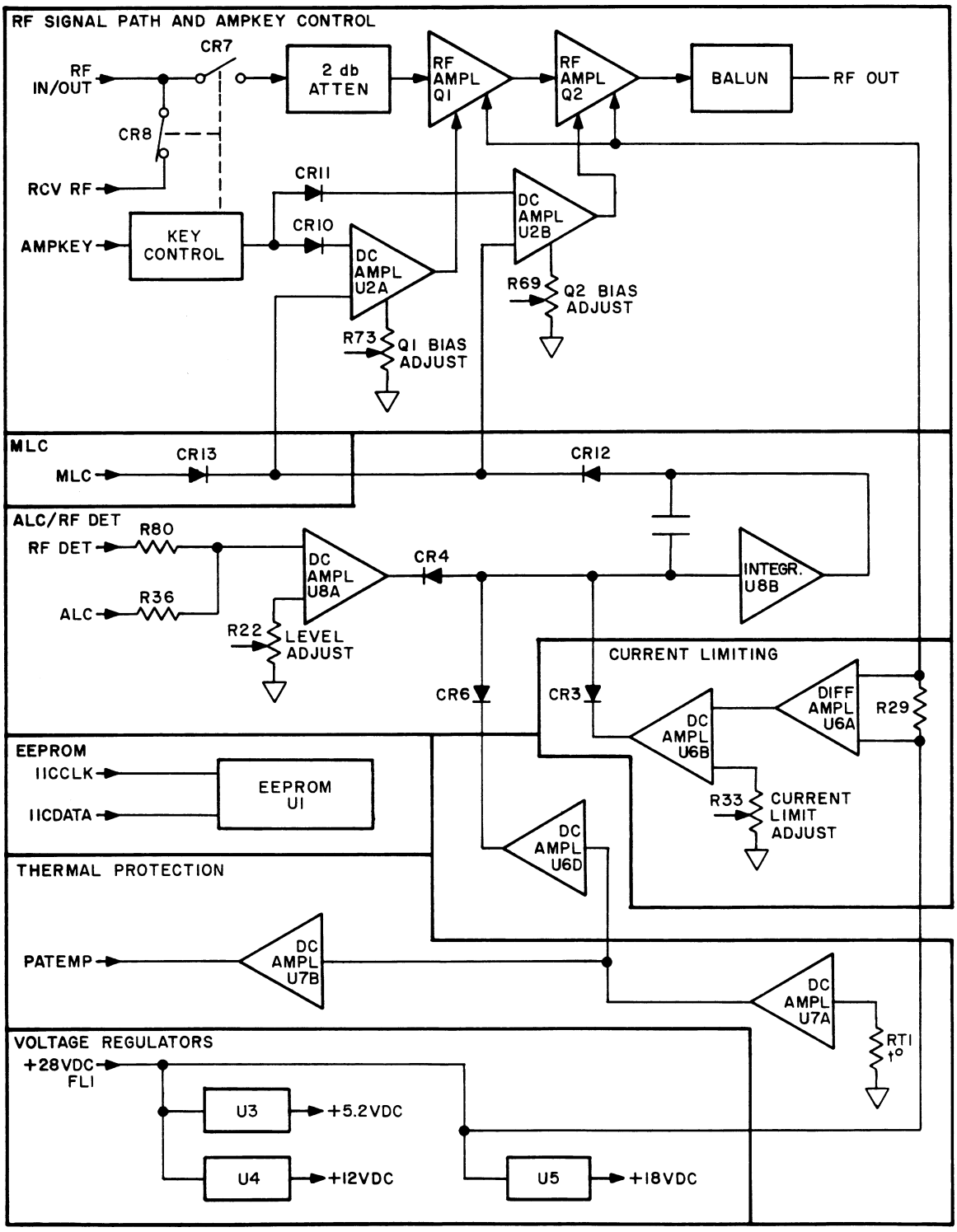


Figure 5-3. 15 Watt Power Amplifier Assembly (A1A6), Functional Block Diagram

CHAPTER 6 MAINTENANCE

6-1 GENERAL.

This chapter provides organizational maintenance instructions for the bi-directional repeater. This includes operational checkout, inspection and preventive maintenance, troubleshooting, and removal/replacement procedures.

6-2 OPERATIONAL CHECKOUT.

Perform the procedures in paragraphs 6-2.1 through 6-2.5 to check the bi-directional repeater for normal operation. These checks should be performed when equipment is used for the first time, when the equipment has been damaged, or if the equipment has not been used for an extended period of time.

NOTE

Prior to conducting the operational checkout, the receiver-transmitter used in the test must be properly programmed and configured. Refer to TO 31R2-2PRC139-1.

6-2.1 Power-up Verification.

Check the bi-directional repeater power-up operation as follows:

a. Ensure that the antenna has been installed as indicated in paragraph 2-10.1. Refer to the bi-directional repeater interconnection diagram (Figure 8-1).

b. Set the bi-directional repeater switches and controls as indicated in Table 6-1.

Table 6-1. Initial Switch and Control Settings for Power-Up Verification

Switch/Control	Position
AC/DC POWER switch (1, Figure 4-2)	OFF
INT/EXT switch (2, Figure 4-2)	INT or EXT, as applicable
MODE SELECT switch (6, Figure 4-1)	RETRANS "¬AB∨
POWER switch (8, Figure 4-1)	2 WATT
DISPLAY switch (1, Figure 4-1)	ON
Radio A Channel	1
Radio B Channel	2

c. Set the AC/DC POWER switch to AC or DC, as applicable. Verify that the green POWER LED (5, Figure 4-1) is the only LED illuminated.

6-2.2 Display Off Control.

Check the functionality of the DISPLAY switch as follows:

a. Place the DISPLAY switch (1, Figure 4-1) in the OFF position. Verify that the green POWER LED (5, Figure 4-1) goes off.

b. Set the DISPLAY switch to ON. Verify that the green POWER LED illuminates.

6-2.3 Radio A Tune Mode Verification.

Verify functionality of receive mode as follows:

a. Set the bi-directional repeater switches and controls as indicated in Table 6-2.

Table 6-2. Initial Switch and Control Settings for Radio A Tune Mode Verification

Switch/Control	Position
AC/DC POWER switch (1, Figure 4-2)	AC or DC, as applicable
INT/EXT switch (2, Figure 4-2)	INT or EXT, as applicable
MODE SELECT switch (6, Figure 4-1)	TUNE A
POWER switch (7, Figure 4-1)	2 WATT
Radio A Channel	1
Radio B Channel	2

b. Verify that the only LEDs illuminated on the bi-directional repeater front panel are POWER and RCV.

c. Verify that the green LED on Radio A receiver-transmitter is illuminated and that the green LED on Radio B receiver-transmitter is not illuminated.

6-2.4 Radio B Tune Mode Verification

Verify functionality of transmit mode as follows:

NOTE

Be aware that while performing the initial power-up and diplexer tuning procedures, the bi-directional repeater will radiate RF energy which can cause frequency interference. Do not perform this procedure before the frequency use authorization is effective.

a. Set the bi-directional repeater switches and controls as indicated in Table 6-3.

Table 6-3. Initial Switch and Control Settings for Radio B Tune Mode Verification

Switch/Control	Position
AC/DC POWER switch (1, Figure 4-2)	AC or DC, as applicable
INT/EXT switch (2, Figure 4-2)	INT or EXT, as applicable
MODE SELECT switch (6, Figure 4-1)	TUNE B
POWER switch (7, Figure 4-1)	2 WATT
Radio A Channel	1
Radio B Channel	2

b. Verify that the only LEDs illuminated on the bi-directional repeater front panel are POWER and XMT.

c. Verify the green LED on Radio B receiver-transmitter is illuminated and the green LED on Radio A receiver-transmitter is not illuminated.

6-2.5 Fault LED.

The red FAULT LED (2, Figure 4-1) on the front panel is illuminated either 1) when the power amplifier temperature is excessive, 2) if there is an RF path fault (the BDR or diplexer is cabled incorrectly, the diplexer is tuned incorrectly, or frequency spacing is less than the recommended minimum), or 3) Radio A has a fault or there is no radio in the Radio A sleeve. A thermistor in the power amplifier will trigger the fault indication when the internal temperature of the power amplifier reaches 90E C (194E F). Power amplifier current draw is decreased slowly until the temperature decreases to approximately 80E C (176E F).

6-3 SERVICING.

6-3.1 Servicing Intervals.

Table 6-4 provides recommended service intervals.

Table 6-4. Recommended Service Intervals

Task	Recommended Interval			
	D	W	M	Q
Visual inspection (see paragraph 6-3.2)	X			
Preventive maintenance:				
Inspection (see paragraph 6-3.3.1)		X		
Cleaning (see paragraph 6-3.3.2)			X	

D = Daily
W = Weekly
M = Monthly
Q = Quarterly

6-3.2 Inspection.

Many potential or existing faults can be detected by making a visual inspection of the equipment. For this reason, a visual inspection should be made on a routine basis or whenever the bi-directional repeater is inoperative.

NOTE

If any discrepancies are observed, return the unit to higher level maintenance.

At a minimum, the following items should be inspected by the operator.

a. Inspect the equipment covers and front panel for condition of finish and panel markings.
b. Inspect for dents, punctures, and warped areas.
c. Inspect external surfaces for loose or missing screws or washers.
d. Inspect the receptacles and connectors for condition of pins, contacts, and mounting.
e. Inspect the antenna for signs of physical damage.
f. Inspect the knobs and switches for mechanical integrity.
g. Inspect LEDs for dust accumulation.

6-3.3 Preventive Maintenance.

The bi-directional repeater requires very little routine maintenance other than inspection and cleaning. The operator shall perform the following procedures at the intervals recommended in Table 6-4.

6-3.3.1 Inspection.

Inspect the bi-directional repeater as follows:

a. Inspect the equipment covers and front panel for condition of finish and panel markings.
b. Inspect the unit for dents, punctures, or worn areas.
c. Inspect external surfaces for loose or missing screws or washers.
d. Inspect the receptacles and connectors for condition of pins, contacts, and mounting.
e. Inspect antenna for signs of physical damage.
f. Inspect the knobs and switches for mechanical integrity.
g. Inspect LEDs for dust accumulation.

6-3.3.2 Cleaning.

Cleaning should be performed to remove accumulated dust and other contaminants. Clean the bi-directional repeater as follows:

a. Dust the switches and LEDs with a soft-bristled brush.

b. Remove dirt clinging to the bi-directional repeater with a clean, lint-free cloth dampened with a mild detergent and water solution. Avoid using abrasive cleaners, as they will scratch the unit's surface.

c. Wipe internal sleeve contacts (connection to the receiver-transmitter) with a clean, dry, lint-free cloth.

d. Clean the receiver-transmitter side connector contacts by rubbing with a soft pencil eraser.

6-4 TROUBLESHOOTING.

Tables 6-5 and 6-6 describe possible system malfunctions, their probable cause(s), and the corrective action required by the operator or the repair specialist to return the equipment to an operational state. All solutions which suggest replacement of an item assume that the item used to make the replacement is a known good item.

Table 6-5 contains the symptoms of possible system malfunctions which can be acted on by the operator. Only those procedures contained within Table 6-5 are authorized to be performed by the operator. Table 6-6 identifies additional possible system malfunctions that can be corrected by the repair specialist. Troubleshooting procedures contained in Tables 6-5 and 6-6 are authorized to be performed by the repair specialist. Prior to performing any repair actions, the repair specialist should perform the following inspections:

a. The repair specialist should inspect those items which were inspected by the operator.

b. Inspect the internal components for signs of deterioration, discoloration, or charring. Check for melted insulation and damage, cracked or broken components.

c. Inspect the printed circuit boards for damaged tracks, loose connections, corrosion, or other sign of deterioration.

d. Inspect the printed circuit (PC) connectors, interface connectors, and chassis wiring for excessive wear, looseness, misalignment, corrosion, or other signs of deterioration.

Before referring to Tables 6-5 or 6-6, ensure that the DISPLAY switch (1, Figure 4-1) is in the ON position, that the receiver-transmitters are correctly programmed and controls are properly set, and that a matching configuration of receiver-transmitters, antennas, and diplexers is installed. Refer to Table 6-7 for cross-reference to removal/replacement procedures.

Table 6-5. Organizational Maintenance Guide - Operator

Symptom	Possible Cause	Remedy
a. Repeater does not have any lamps illuminated, and b. Repeater does not receive or transmit with power and modulation	Failed power source	Restore prime power
	Failed batteries	Replace batteries/check power source
	Failed Radio A	Replace Radio A
	Failed Radio B	Replace Radio B
	Failed power cable(s)	Replace power cable(s)
	Failed power supply	Replace power supply
	Failed BDR assembly	Return the BDR assembly to the repair specialist for repair
Fault LED is illuminated constantly	RF power amplifier temperature is excessive (greater than 90°C).	Turn off BDR until temperature decreases. If LED again illuminates, return BDR to the repair specialist.
	No or faulty radio in sleeve A	Check that Radio A is locked in place and is good
Fault LED is illuminated intermittently	RF path fault (diplexer or BDR cabled incorrectly)	Verify proper cable connections to BDR and diplexer
	Diplexer tuned incorrectly	Check diplexer tuning
	Frequency spacing less than minimum	Check radio programming for receive and transmit frequencies
a. Repeater does not have any lamps illuminated, and	DISPLAY knob turned to OFF or is loose	Check position of DISPLAY knob
b. Repeater receives and transmits with power and modulation	Failed BDR assembly	Return the BDR assembly to the repair specialist for repair
Repeater does not receive at any frequency and no front panel indicators are illuminated	Bad or no programming	Check radio programming for receive and transmit frequencies
	Failed diplexer	Replace diplexer
	Failed lightning protection device	Replace lightning protection device
	Failed antenna	Replace antenna
	Failed antenna cable	Replace antenna cable
	Failed RCV receiver transmitter	Replace receiver-transmitter
	Failed BDR assembly	Return the BDR assembly to the repair specialist

Table 6-5. Organizational Maintenance Guide - Operator - CONT

Symptom	Possible Cause	Remedy
Repeater constantly transmits without valid signal	Bad or no programming	Check receiver-transmitters for proper frequency information - correct if required
	Failed Radio A	Replace Radio A
	Failed Radio B	Replace Radio B
	Failed BDR assembly	Return the BDR assembly to the repair specialist
Repeater transmits with correct power but with no modulation	Failed Radio A	Replace Radio A
	Failed Radio B	Replace Radio B
	Failed BDR assembly	Return the BDR assembly to the repair specialist
a. Repeater receives but with degraded sensitivity, and b. Repeater transmits with correct power and modulation	Mismatched antenna	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed antenna	Replace antenna
	Failed Radio A	Replace Radio A
	Mismatched diplexer	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed diplexer	Replace diplexer
	Failed bi-directional repeater assembly	Return the bi-directional repeater assembly to the repair specialist for repair
a. Repeater transmits with no power and modulation or degraded power and modulation, and b. Repeater receive characteristics meets specified levels	Improper diplexer adjustment	Perform diplexer adjustment
	Mismatched diplexer	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed diplexer	Replace diplexer
	Bad or no programming	Check receiver-transmitters for proper frequency information - correct if required
	Mismatched antenna	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed antenna	Replace antenna
	Failed antenna cable	Replace antenna cable
	Failed Radio B	Replace Radio B
	Failed BDR assembly	Return the BDR assembly to the repair specialist

Table 6-5. Organizational Maintenance Guide - Operator - CONT

Symptom	Possible Cause	Remedy
Repeater receive characteristics are frequency sensitive; some but not all frequencies meet specified levels	Mismatched receiver-transmitter	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed Radio A	Replace Radio A
	Mismatched diplexer	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed diplexer	Replace diplexer
	Mismatched antenna	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed antenna	Replace antenna
	Failed antenna cable	Replace antenna cable
	Failed BDR assembly	Return the BDR assembly to the repair specialist
Repeater transmit characteristics are frequency sensitive; some but not all frequencies meet specified levels	Mismatched receiver-transmitter	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed Radio A	Replace Radio A
	Mismatched diplexer	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed diplexer	Replace diplexer
	Mismatched antenna	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed antenna	Replace antenna
	Failed antenna cable	Replace antenna cable
	Failed BDR assembly	Return the BDR assembly to the repair specialist
Repeater has some indicators working but not all	Failed Radio A	Replace Radio A
	Failed Radio B	Replace Radio B
	Failed BDR assembly	Return the BDR assembly to the repair specialist
Repeater will not pass either clear or encrypted data or passes distorted audio signal	Failed Radio A	Replace Radio A
	Failed Radio B	Replace Radio B
	Failed BDR assembly	Return the BDR assembly to the repair specialist
Unable to power radio through side connector	Failed receiver-transmitter	Return the receiver-transmitter to the repair specialist

Table 6-6. Organizational Maintenance Guide - Repair Specialist

Symptom	Possible Cause	Remedy
a. Repeater does not have any lamps illuminated, and b. Repeater does not receive or transmit with power and modulation	Failed repeater control CCA	Remove and replace repeater control CCA
	Fault cannot be isolated/repaired at the repair specialist level	Return the BDR assembly to depot for repair
a. Repeater does not have any lamps illuminated, and b. Repeater receives and transmits with power and modulation	Failed control panel assembly	Remove and replace control panel assembly
	Fault cannot be isolated/repaired at the repair specialist level	Return the BDR assembly to depot for repair
Repeater does not receive at any frequency and no front panel indicators are illuminated	Failed repeater control CCA	Remove and replace repeater control CCA
	Fault cannot be isolated/repaired at the repair specialist level	Return the BDR assembly to depot for repair
Fault LED is illuminated constantly	RF power amplifier temperature is excessive (greater than 90^{o}C)	Remove and replace 15W RF power amplifier assembly
	Fault cannot be isolated/repaired at the repair specialist level	Return the BDR assembly to depot for repair
Fault LED is illuminated intermittently	RF path fault (diplexer or BDR cabled incorrectly)	Verify proper cable connections to BDR and diplexer
	Fault cannot be isolated/repaired at the repair specialist level	Return the BDR assembly to depot for repair
Repeater constantly transmits without valid signal	Fault cannot be isolated/repaired at the repair specialist level	Return the BDR assembly to depot for repair
Repeater transmits with correct power but with no modulation	Fault cannot be isolated/repaired at the repair specialist level	Return the BDR assembly to depot for repair
a. Repeater receives but with degraded sensitivity, and b. Repeater transmits with correct power and modulation	Fault cannot be isolated/repaired at the repair specialist level	Return the BDR assembly to depot for repair
a. Repeater transmits with no power and modulation or degraded power and modulation, and b. Repeater receive characteristics meets specified levels	Fault cannot be isolated/repaired at the repair specialist level	Return the BDR assembly to depot for repair
Repeater receive characteristics are frequency sensitive; some but not all frequencies meet specified levels	Fault cannot be isolated/repaired at the repair specialist level	Return the BDR assembly to depot for repair

Table 6-6. Organizational Maintenance Guide - Repair Specialist - CONT

Symptom	Possible Cause	Remedy
Repeater transmit characteristics are frequency sensitive; some but not all frequencies meet specified levels	Fault cannot be isolated/repaired at the repair specialist level	Return the BDR assembly to depot for repair
Repeater has some indicators working but not all	Fault cannot be isolated/repaired at the repair specialist level	Return the BDR assembly to depot for repair
Repeater will not pass either clear or encrypted data or passes distorted audio signal	Failed repeater control CCA	Remove and replace repeater control CCA
Unable to power radio through side connector	Failed receiver-transmitter	Return the receiver-transmitter to the depot for repair

Table 6-7. Cross-Reference to Removal/Replacement Procedures

Items to be Removed/Replaced	Applicable Procedure (Paragraph Number)
Antenna	6-5.1.2
Antenna cable	6-5.1.1
Control panel assembly (A1A5)	6-5.2.2
Diplexer	6-5.1.7
Power cable	6-5.1.4
Power supply	6-5.1.5
Receiver-transmitter	6-5.1.3
Repeater control CCA (A1A2)	6-5.2.1
Bi-directional repeater assembly	6-5.1.6
15 watt power amplifier assembly (A1A6)	6-5.2.3

6-5 REMOVAL/REPLACEMENT PROCEDURES

6-5.1 Removal/Replacement Procedures - Operator

The first step for any removal/replacement procedure is to power down the equipment. Then remove all accessories (antenna, handset, etc.). Removal/replacement procedures which are authorized to be performed by the operator are given in paragraphs 6-5.1.1 through 6-5.1.7.

WARNING

Before performing removal/replacement procedures, make sure power is removed from the unit by disconnecting from power source. Failure to do so could result in personal injury or equipment damage.

6-5.1.1 Antenna Cable Removal/Replacement.

Remove/replace antenna cable as follows:

a. Disconnect the antenna cable from the Antenna connector on the power supply by turning counterclockwise.

b. Disconnect the antenna cable from the connector at the base of the antenna mast by grasping the connector on the antenna cable and turning counterclockwise.

c. Replace with a new antenna cable onto the connectors on the antenna mast and power supply.

6-5.1.2 Antenna Removal/Replacement.

Remove/replace the antenna as follows:

WARNING

This equipment is capable of generating RF power sufficient to cause RF burns. During transmit, care should be taken to eliminate the possibility of touching exposed RF output points such as the center conductors of coaxial cables or antenna feedpoints.

a. Disconnect the antenna from the antenna connector mounted on the mast by removal of mounting hardware.

b. Disconnect the coaxial cable.

c. Replace the antenna with a known good antenna.

6-5.1.3 Receiver-Transmitter Removal/Replacement.

Remove/replace Radio A or Radio B as follows:

a. Remove the receiver-transmitter from the bi-directional repeater by turning the locking knob on the front panel counterclockwise one-quarter turn.

b. Pull the receiver-transmitter from the sleeve.

c. Reinsert a known good receiver-transmitter into the bi-directional repeater.

6-5.1.4 Power Cable Removal/Replacement.

Remove/replace power cable as follows:

a. Disconnect the power cable from the connector at the rear of the bi-directional repeater by grasping the base of the power cable connector and turning counterclockwise.

b. Disconnect the power cable from the connector on the power supply by grasping the base of the power cable connector and turning counterclockwise.

c. Replace a new power cable onto the connectors on the bi-directional repeater and power supply.

6-5.1.5 Power Supply Removal/Replacement.

Remove/replace the power supply as follows:

a. Remove the diplexer per paragraph 6-5.1.7.

b. Disconnect the external power cable (Figure 7-1, 46, 47, or 48) and the power supply cable (32) by grasping the base of each power cable and turning counter-clockwise.

c. Disconnect coaxial cables W2 and W3 from the BDR unit.

d. Remove the screws (22) holding the power supply mounting plate to the weldment frame (5). Slide the power supply to the right (as seen from the front) and lift the left edge of the mounting plate to clear the frame.

e. Lift the power supply from the frame and place on a workbench upside down next to the new power supply.

f. Remove the two cable clamps (26, 29) holding cable W2 from the bottom of the mounting plate and attach clamps and cable to the corresponding mounting holes on the new power supply. Similarly, transfer the two cable clamps holding cables W3 and W4 to the new power supply.

g. Place the new power supply on the frame, tilting the power enclosure side down for clearance of the frame.

h. Position the new power supply on the frame. Align the holes in the mounting plate with the holes in the frame and bolt the power supply into place.

i. Reattach the remaining cables.

j. Reinstall the diplexer per paragraph 6-5.1.7.

6-5.1.6 Bi-directional Repeater Assembly Removal/Replacement.

Remove/replace the bi-directional repeater assembly as follows:

a. Disconnect the coaxial cables (30, 31, Figure 7-1), the power cable (32), and the grounding strap (34).

b. Loosen the two machine screws holding the front clamp in place, using a #2 Phillips head screwdriver and a 7/16 box end wrench.

c. Raise the front of the bi-directional repeater assembly (1) and slide it forward.

d. Replace the bi-directional repeater with a known good bi-directional repeater.

6-5.1.7 Diplexer Removal/Replacement.

Remove/replace the diplexer as follows:

a. To remove the diplexer (33, Figure 7-1), disconnect the coaxial cables (23(W3), 30(W2), and 31(W4)) leading to the bi-directional repeater assembly (1) and the power supply (21).

b. Remove the screws (35), washers (36), and shock mount components (24, 27, and 28) under the diplexer holding the diplexer to the weldment frame (5). Detailed assembly of the four shock mounts is shown in Figure 6-1.

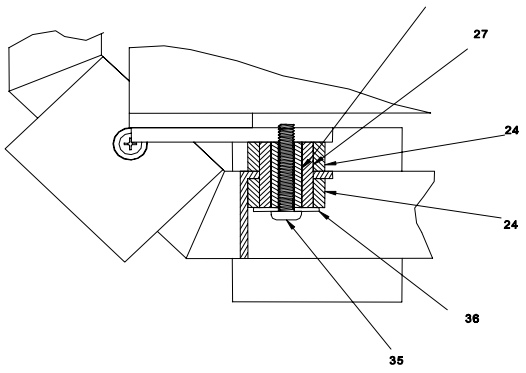


Figure 6-1. Detail of diplexer shock mount assembly

c. Replace the diplexer with a known good diplexer for the same frequency band. When replacing the diplexer, ensure that the mounting holes on the bottom of the diplexer are aligned with the correct holes on the frame so that the front of the diplexer is at the front of the frame.

d. Reconnect the coaxial cables to the diplexer: W3 to TX, W2 to RX, and W4 to ANT. Sheet 2 of Figure 1-1 shows the positions of each connector on the back of the diplexer. Ensure that the connectors are finger tight. Refer to Figure 8-1 for correct interconnections.

6-5.2 Removal/Replacement Procedures - Repair Specialist

These procedures are authorized to be performed by the repair specialist only, and are in addition to those performed by the operator. These procedures are not applicable to the operator. Prior to performing any remove/replace procedures, ensure the equipment is powered down and disconnected from the power source and remove all accessories (antenna cable). To replace components into the bi-directional repeater, reverse the removal procedures, unless otherwise directed.

WARNING

Before performing removal/replacement procedures, make sure power is removed from the unit by disconnecting from power source. Failure to do so could result in personal injury or equipment damage.

CAUTION

ELECTROSTATIC DISCHARGE

The bi-directional repeater contains components that are susceptible to damage by static electrical charges. Disassembly of the bi-directional repeater should only be done at a properly grounded work station.

6-5.2.1 Repeater Control Circuit Card Assembly (CCA) (A1A2) (4101029-501) Removal/Replacement.

Remove/replace the repeater control CCA (A1A2) as follows:

a. Remove the bottom cover (20, Figure 7-2) by removing the 16 screws (7) that secure the bottom cover to the chassis.

b. Unplug the repeater control CCA (A2) (21) by pulling evenly on the card connectors at each end of the card.

c. Replace with a known good repeater control CCA (A2) by pushing evenly on the card extractors at each end of the card. Ensure that the card edges are aligned with the tracks on the sides of the chassis.

d. Reattach the bottom cover by tightening the 16 screws that secure the bottom cover to the chassis. When refitting the bottom cover to the chassis, check the EMI gasket (19) to ensure that it is undamaged and properly seated.

6-5.2.2 Control Panel Assembly (A1A5) (4101032-501) Removal/Replacement.

Remove/replace the control panel assembly (A1A5) as follows:

a. Loosen the eight captive screws securing the control panel (29, Figure 7-2) to the bi-directional repeater chassis (13).

b. Pull the control panel straight out from the chassis.

c. To replace, reverse the above steps.

6-5.2.3 15 Watt Power Amplifier Assembly (A6) (SS-4100853-501) Removal/Replacement.

Remove/replace the power amplifier (PA) assembly (A1A6) as follows:

a. Place the bi-directional repeater upside down.

b. Remove the bi-directional repeater bottom cover.

c. Pull clamps away from connector on J4 on parent board. Remove connector of amplifier control cable assembly (A6W1).

d. Turn bi-directional repeater over; leave cover off.

e. The 15 watt power amplifier assembly (A6) (1, Figure 7-2) is mounted on the top of the bi-directional repeater chassis (13). First, unscrew the 20 captive screws (2, Figure 7-3) that hold the PA assembly to the chassis. Grasp one of the heatsink fins and slightly raise the front end of the PA assembly.

f. Use a 5/16" wrench to unscrew the cable connector on coaxial RF cable assembly W5 from connector J2 (RF IN/OUT) on the PA assembly and pull the cable from the connection.

g. Use a 5/16" wrench to unscrew the cable connector on coaxial RF cable assembly W9 from connector A7J4 on inner back panel of the BDR unit and pull the cable from the connection.

h. Detach the amplifier power cable (A6W9) at the in-line plug connector.

i. Lift the 15 watt power amplifier assembly from the bi-directional repeater unit.

j. To replace, reverse the above steps.

CHAPTER 7 ILLUSTRATED PARTS BREAKDOWN

Section I. INTRODUCTION

7-1 GENERAL

The Illustrated Parts Breakdown (IPB) lists, illustrates, and describes the parts used in the BDR, Radio Set AN/TRC-6728. The items are manufactured by Racal Communications, Inc., Rockville, Maryland.

7-2 MAINTENANCE PARTS LIST

The Maintenance Parts List (MPL), (Section II), consists of the complete systems divided into main groups. The main groups are broken down into assemblies, subassemblies, and details. The next higher assembly (NHA) is indicated for each separately illustrated item. Each assembly and subassembly listed is followed immediately by its component parts. In general, the assemblies and parts installed at the time the end item was manufactured are listed and identified in the manual. When an assembly/part (including vendor items) different from the original was installed during manufacture of the later items, series, or blocks, all assemblies and parts are listed (and "Usable on" coded). However, when the original assembly or part does not have continued application, only the preferred assembly or part is listed. When an assembly/part installed during modification, and the original does not have continued application, only the preferred item is listed. Interchangeable and substitute assemblies and parts, subsequently authorized by the Government, are not listed in this manual. When a standard size part can be replaced with an oversize/undersize part, the latter parts, showing sizes, are also listed.

a. Figure and Index Number Column. This column lists the figure and index number of each part illustrated in the related figure. The index numbers are in numerical sequence and indicate order of disassembly except where the order does not apply. Index numbers identify each part number shown in the related figure. Assemblies which have detail parts indexed are not indexed unless; the assembly is illustrated completely assembled on the same illustration; or it is identified as an assembly by bracketing or circling of components. When a group of parts (bolt, washer, nut) is used at a specific location for attachment purposes, one index number assigned is sufficient. The index number appears on the same line as the first part composing the group.

b Part Number Column. This column lists the contractor's part number (drawing number), including dash numbers, assigned to each part. Vendor part numbers are listed when parts are identical to the contractor used part. Those parts which have Government Standards numbers assigned have the Government Standards number listed. Parts altered or selected for special fit, tolerance, etc., from vendor, commercial, or Government Standards part number of the altered or selected part follow the part description in the Description column. Item(s) of supply part number(s) and Contractor and Government Entity (CAGE) that is stocked, stored, and issued by the Government as identified by the Government during the initial provisioning process shall be identified by an (*) sign preceding the part number one space to the left. Government Furnished Equipment (GFE) and Contractor Furnished Equipment (CFE), covered by separate manuals are listed and identified by a number sign (#) inserted flush right following the part number. Decalcomania, metal-cals, and vinyl film markings are considered as parts. The part number for each marking will be followed by a asterisk (*) symbol inserted flush right. Requisition the marking in accordance with the requirements of AFR 6-1.

c. CAGE Column. This column contains a five-digit code number following the part number denoting the procuring vendor. The source of vendor code numbers is the CAGE for Manufacturer Cataloging Handbook H4-1, H4-2, and H4-3. When a CAGE for the appropriate manufacturer or Government agency is not published in the current issues of the H4 handbook, the word "none" will appear in this column.

d. Description Column. This column contains the description of all items appearing on the MPL. The indentation headed "1" through "7" consists of the approved item name, as found in the Federal Item Identification Guide for Supply Catalog Handbook H6-1, or is in accordance with the contractor's drawing title. The description contains modifiers necessary to identify the particular item. Additional information following the item description may include the following: a list of alternate part numbers to give stock ordering information; exceptions to the Usable On Code for the item; and references to preceding and subsequent figures concerning assemblies and subassemblies. This data is considered an integral part of the item description assuring the correctness of repair maintenance procedures.

e. Attaching Parts. Items used to attach parts or assemblies to each other are listed immediately after the part. The attaching parts have the same indentation code as the parts attached. The code (AP) appears on the same line with and immediately following the attaching part item.

f. Units Per Assembly. This column contains the number of units required per assembly and/or subassembly. If more than one assembly is required, the total number of assemblies is listed. When an assembly or subassembly is listed more than once, the total number of units per assembly or subassembly appears the first time and REF for subsequent listings.

g. Usable on Code Column. This column shows the Usable On Codes for systems, assemblies, and parts indicating specific usability by part number. Usable on code explanations are located at the bottom of the applicable page. The codes A, B, C, etc., when shown within a group, relate the part back to the same coded part within the next higher assembly. When this column is left bank, an assembly or part is common to all part number variation of the next higher assembly.

h. Source, Maintenance, and Recoverability (SMR) Codes. This manual contains Joint Military Services Uniform SMR codes. Detailed coding criteria may be obtained from T.O. 00-25-195.

7-3 NUMERICAL INDEX

The Numerical Index (Chapter 7, Section III) is compiled in accordance with the numerical part number filing system described in paragraph a.

a. Part Number Column. This column contains all the part numbers that appear in the Maintenance Parts List and part numbers that have been assigned to detail parts assembled into the end article. The order of procedure establishing the precedence in which the part numbers are listed is explained below. The order of precedence in the first position of each part number is Letters A through Z, Numerals 0 through 9.

NOTE

Alphabetical O's are considered as numerical zeroes in all positions in each part number.

The order of precedence in the second and succeeding positions in each part number is as follows:

(1) Space (blank column).
(2) Diagonal (/).
(3) Period (.).
(4) Dash (-).
(5) Letters A through Z.
(6) Numerals 0 through 9.

The following is a sample of part numbers arranged in alphabetical-numerical sequence used in the Numerical Index.

AN931-4-13	B2	16.W2
A2460	S/1	16W060
A317	1140	32P010.1
A32	121873	32P0101

b. Figure and Index Number Column. For each part number, the figure or figure and index number refers to the MPL where the parts relationship is shown. When an assembly or part has not been assigned an index number, the figure and index number of the preceding part in the MPL is used with the letter "F" before the figure, such as F7-7. The letter "F" denotes "follows".

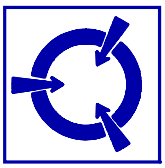
7-4 REFERENCE DESIGNATION INDEX

The Reference Designation Index (Chapter 7, Section IV) is listed by figure as it appears in the MPL, then in alphabetical-numerical order, the reference designations used in schematic diagrams and instruction books. Opposite the reference designation is listed the figure index number as shown in the MPL.

7-5 ELECTROSTATIC DISCHARGE (ESD) SENSITIVE DEVICES.

a. This technical order contains parts and assemblies sensitive to damage by ESD. T.O. 00-25-234 should be consulted for specific information on how damage can occur to electronic parts, assemblies, and equipment by ESD and the control measures to be taken to protect against such damage.

b. Illustrations contained within this manual which depict ESD parts are further identified by the use of the following symbol affixed in the lower right-hand corner of each applicable illustration.

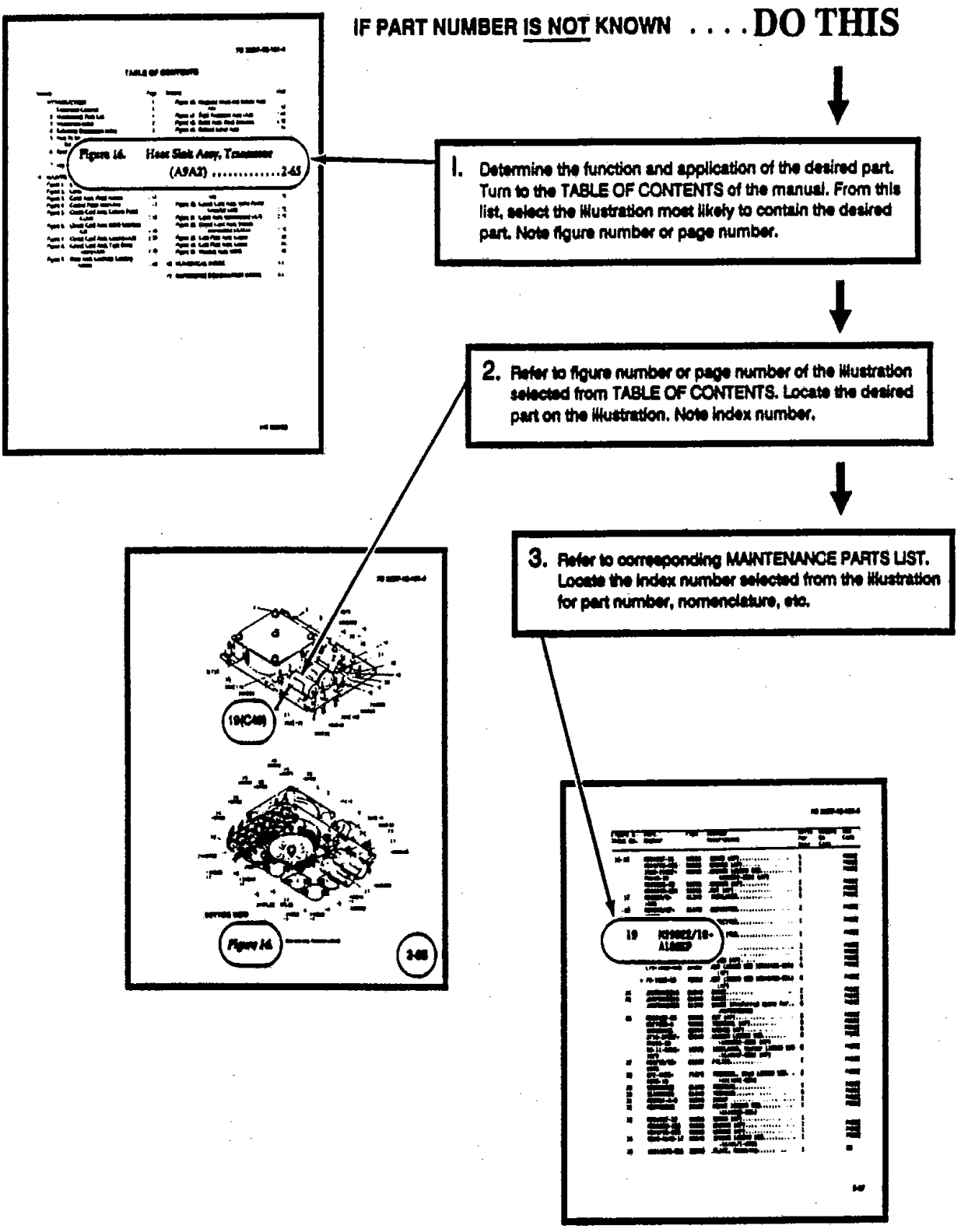


c. The MPL contained within this manual with ESD sensitive parts are identified by the following symbol (ESD). These symbols are placed in the extreme right of the description column for the item as ESD sensitive.

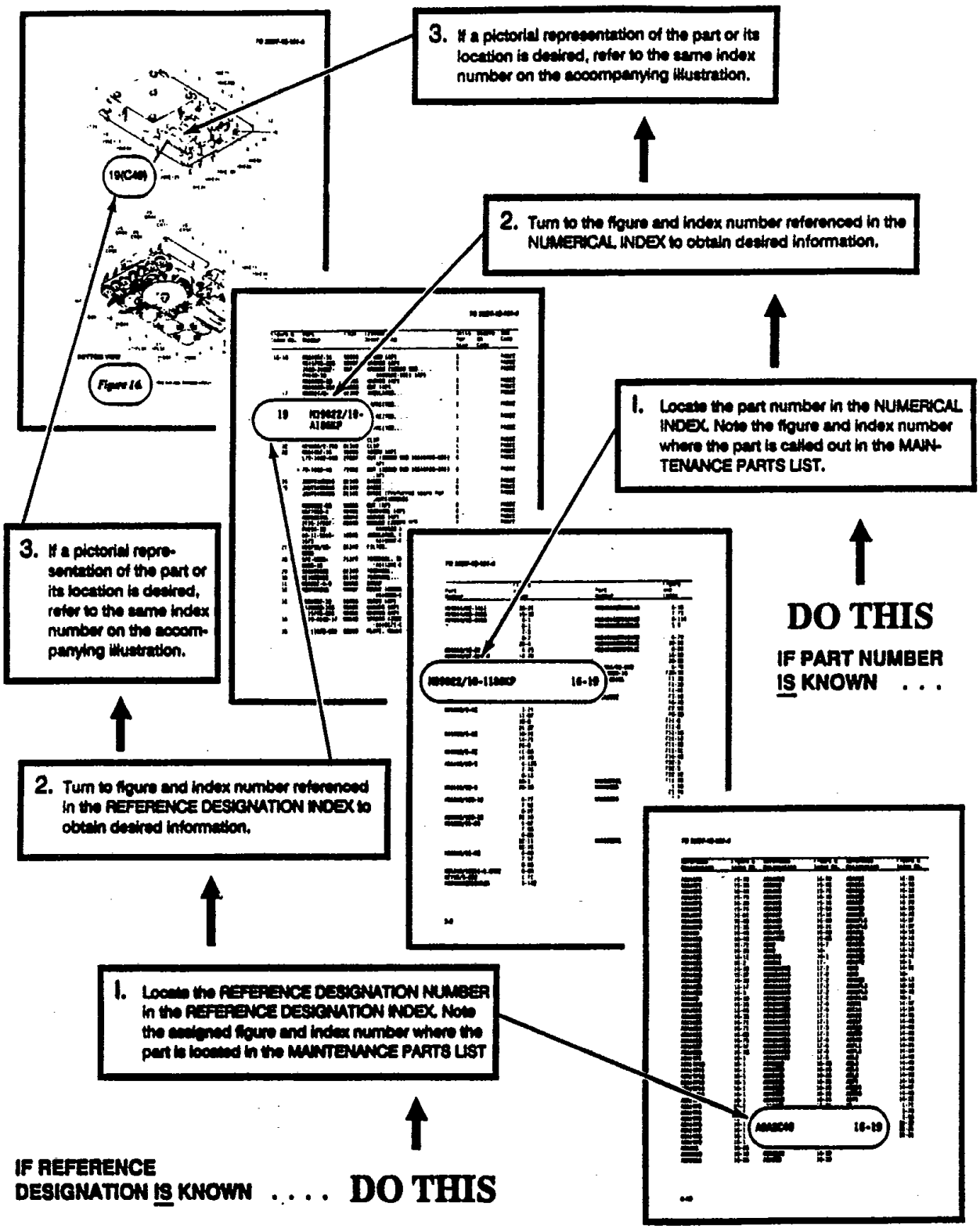
7-6 CAGE CODE SUMMARY

CAGE Code	Manufacturer
1BZ19	C and S Antennas, Inc.
05972	Loctite Corp.
07700	Technical Wire Products, Inc.
13074	Multi-Flex Seals, Inc.
23386	Racal Communications, Inc.
23657	Shakespeare Co.
27264	Molex Inc.
52437	Bretford MFG, Inc.
73734	Federal Screw Products, Inc.
74790	National Lightening Corp.
76385	Minor Rubber Co., Inc.
79557	Vertex Computer Cable and Products
81349	Military Specifications
82820	Reif M. M. and Co., Inc.
85480	Brady W. H. Co.
86928	Seastorm MFG Co., Inc.
96906	Military Standards

HOW TO USE THE ILLUSTRATED PARTS BREAKDOWN


IF PART NUMBER IS NOT KNOWN . . . . DO THIS
1. Determine the function and application of the desired part. Turn to the TABLE OF CONTENTS of the manual. From this list, select the illustration most likely to contain the desired part. Note figure number or page number.
2. Refer to figure number or page number of the illustration selected from TABLE OF CONTENTS. Locate the desired part on the illustration. Note index number.
3. Refer to corresponding MAINTENANCE PARTS LIST. Locate the index number selected from the illustration for part number, nomenclature, etc.

HOW TO USE THE ILLUSTRATED PARTS BREAKDOWN


3. If a pictorial representation of the part or its location is desired, refer to the same index number on the accompanying illustration.
2. Turn to the figure and index number referenced in the NUMERICAL INDEX to obtain desired information.
1. Locate the part number in the NUMERICAL INDEX. Note the figure and index number where the part is called out in the MAINTENANCE PARTS LIST.
DO THIS
IF PART NUMBER IS KNOWN . . .
3. If a pictorial representation of the part or its location is desired, refer to the same index number on the accompanying illustration.
2. Turn to figure and index number referenced in the REFERENCE DESIGNATION INDEX to obtain desired information.
1. Locate the REFERENCE DESIGNATION NUMBER in the REFERENCE DESIGNATION INDEX. Note the assigned figure and index number where the part is located in the MAINTENANCE PARTS LIST
IF REFERENCE DESIGNATION IS KNOWN . . . . DO THIS

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Section II. MAINTENANCE PARTS LIST

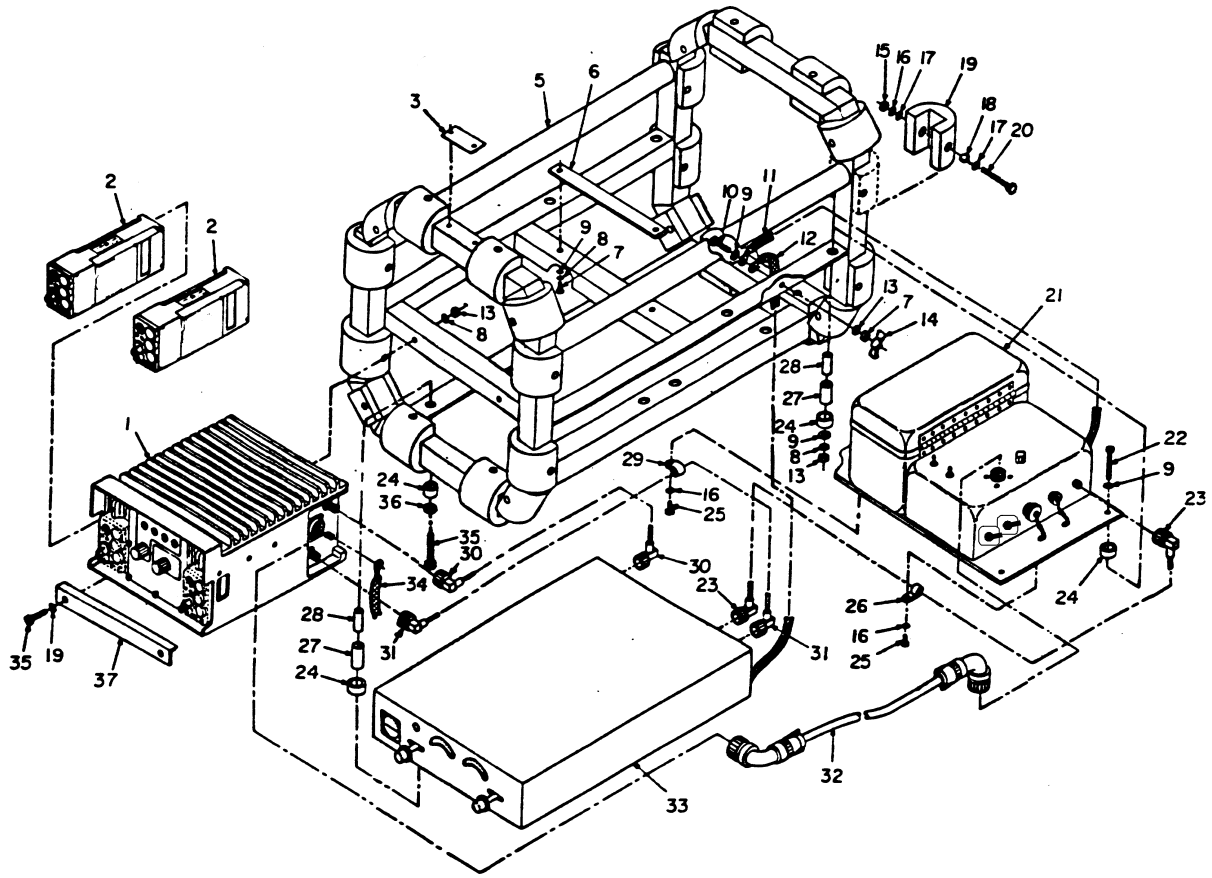


Figure 7-1. Radio Set AN/TRC-207 (Sheet 1 of 2)

Figure 7-1. Radio Set AN/TRC-207 (Sheet 2 of 2)

TO 31R2-2TRC207-1

Table 7-1. Radio Set AN/TRC-207

Figure & Index No.	Part Number	CAGE	Description 1 2 3 4 5 6 7	Units per Assy	Usable on Code	SMR Code
7-1	4101025-501	23386	Radio Set AN/TRC-207 ..... (refer to Figure 7-1 for breakdown)	0001		PEODDS
7-1-1 (A1)	4101027-501	23386	@ BDR Assembly ..... (refer to Figure 7-2 for breakdown)	0001		PAOLDT
7-1-2 (A4,A5)	SS-4100807-512	23386	@ Receiver-Transmitter, RT-1695/ TRC-199 (refer to T.O 31R2-2PRC139-3 for breakdown)	0002		PAOLDT
7-1-2a	SS-3100552-501	23386	@@ Case, Transceiver	0004		PAOZZN
7-1-3	SS-2400605-2	23386	@ Label, Identification.....	0001		XB
7-1-4	Not used					
7-1-5	SS-4400225-1	23386	@ Frame, Repeater, Weldment	0001		XB
7-1-6	SS-3100546-501	23386	@ Clamp Assy, Rear	0001		XB
7-1-7	MS51957-79	96906	@ Screw, Machine ..... (23386/77682) (SPEC CTRL DRW)	0002		PAOZZN
7-1-8	MS35338-139	96906	@ Washer, Lock..... (23386/75006) (SPEC CTRL DRW)	0008		PAOZZN
7-1-9	MS15795-810	96906	@ Washer, Flat..... (23386/75029) (SPEC CTRL DRW)	0014		PAOZZN
7-1-10	MS51957-84	96906	@ Screw, Machine ..... (23386/77682) (SPEC CTRL DRW)	0001		PAOZZN
7-1-11 (W7)	SS-3500279-504	23386	@ Strap Assy, Ground.....	0001		MDF
7-1-12 (W6)	SS-3500279-503	23386	@ Strap Assy, Ground.....	0001		MDF
7-1-13	MS35690-410	96906	@ Nut, Plain Hex ..... (23386/75211) (SPEC CTRL DRW)	0007		PAOZZN
7-1-14	71206	73734	@ Nut, Wing ..... (23386/SS-754007) (SPEC CTRL DRW)	0001		PAOZZN
7-1-15	MS35650-104	96906	@ Nut, Plain, Hexagon..... (23386/75210) (SPEC CTRL DRW)	0024		PAOZZN
7-1-16	MS35338-138	96906	@ Washer, Lock..... (23386/75005) (SPEC CTRL DRW)	0028		PAOZZN
7-1-17	MS15795-842	96906	@ Washer, Flat..... (23386/SS-75037) (SPEC CTRL DRW)	0048		PAOZZN
7-1-18	9286-A194-16AB	06540	@ Spacer ..... (23386/SS-SP04-030) (SPEC CTRL DRW)	0048		PAOZZN
7-1-19	SS-3400353-1	23386	@ Bumpers TR, Frame.....	0024		XB

Figure & Index No.	Part Number	CAGE	Description 1 2 3 4 5 6 7	Units per Assy	Usable on Code	SMR Code
7-1-20	MS51958-73	96906	Screw, Machine (23386/SS-77776) (SPEC CTRL DRW)	0024		PAOZZN
7-1-21 (A2)	4101028-501	23386	Power Supply (refer to T.O 31R2-2TRC-207-3 for breakdown)	0001		PAOLDT
7-1-22	MS51957-87	96906	Screw, Machine (23386/SS-77691) (SPEC CTRL DRW)	0004		PAOZZN
7-1-23 (W4)	SS-3500292-503	23386	Cable Assy, Coaxial	0001		XB
7-1-24	SS-2400578-1	23386	Washer, Shock Mount	0016		XB
7-1-25	MS51958-61	96906	Screw, Machine (23386/77763) (SPEC CTRL DRW)	0004		PAOZZN
7-1-26	MS21919WDG7	96906	Clamp, Cable (23386/SS-81281) (SPEC CTRL DRW)	0002		PAOZZN
7-1-27	SS-2400577-1	23386	Bushing, Shock Mount	0008		XB
7-1-28	9268-A257-16	06540	Spacer (23386/SS-SP04-031) (SPEC CTRL DRW)	0008		PAOZZN
7-1-29	MS21919WDG4	96906	Cable, Clamp (23386/SS-81284) (SPEC CTRL DRW)	0002		PAOZZN
7-1-30 (W2)	SS-3500292-504	23386	Cable Assy, Coaxial	0001		XB
7-1-31 (W3)	SS-3500292-505	23386	Cable Assy, RF Coaxial	0001		XB
7-1-32 (W1)	4500117-501	23386	Cable Assembly, Power Supply	0001		PAOZZN
7-1-33 (A3)	SS-1600322-501	23386	Diplexer Assembly 30-88 MHz	0001		PAODDT
7-1-33 (A3)	SS-1600322-502	23386	Diplexer Assembly 136-174 MHz	0001		PAODDT
7-1-33 (A3)	SS-1600322-503	23386	Diplexer Assembly 403-470 MHz	0001		PAODDT
7-1-34 (W5)	SS-3500279-502	23386	Strap Assy, Ground	0001		MDF
7-1-35	MS51957-85	96906	Screw, Machine (23386/77689) (SPEC CTRL DRW)	0006		PAOZZN
7-1-36	5712-61-63*	86928	Washer, Flat (23386/75171) (SPEC CTRL DRW)	0008		PAOZZN
7-1-37	SS-3400355-1	23386	Clamp, Front	0001		XB
7-1-38	4266-RAC	23657	Antenna, 403-470 MHz (23386/SS-1600230-3) (SPEC CTRL DRW)	0001		PAOZZN

Figure & Index No.	Part Number	CAGE	Description 1 2 3 4 5 6 7	Units per Assy	Usable on Code	SMR Code
7-1-39	SP10SS	1BZ19	@ Mast Kit, Tactical Repeater ..... (23386/SS-1600281-1) (SPEC CTRL DRW)	0001		PAOZZN
7-1-39a	SL/33644	1BZ19	$ $ Antenna Adapter	0001		PAOZZN
7-1-39b	SL33641SH1	1BZ19	$ $ Top Guy Rope Assy (Green)	0003		PAOZZN
7-1-39c	SL33641SH2	1BZ19	$ $ Middle Guy Rope Assy (Black)	0003		PAOZZN
7-1-39d	AR31EF	1BZ19	$ $ Mast Section	0002		PAOZZN
7-1-39g	F209	1BZ19	$ $ Base Plate.....	0001		PAOZZN
7-1-39h	SL32223	1BZ19	$ $ Ground Anchor	0003		PAOZZN
7-1-39j	DG33640	1BZ19	$ $ Guy Plate.....	0001		PAOZZN
7-1-39k	Q86	1BZ19	$ $ Ground Spike	0002		POAZZN
7-1-39l	SL33642-1	1BZ19	$ $ Transit Bag.....	0001		PAOZZN
7-1-40	4265-RAC	23657	@ Antenna,136-174 MHz ..... (23386/SS-1600230-2) (SPEC CTRL DRW)	0001		PAOZZN
7-1-41	4242-MK2-RAC	23657	@ Antenna,30-88 MHz ..... (23386/SS-1600230-1) (SPEC CTRL DRW)	0001		PAOZZN
7-1-42 (W10)	CPRG223/U-30-XX	79557	@ Cable, Coaxial, Antenna ..... (23386/SS-1600315-1) (SPEC CTRL DRW)	0001		PAOZZN
7-1-44	275-160-070-000	52473	@ Case, Transit, Diplexer ..... (23386/SS-1600352-1) (SPEC CTRL DRW)	0001		PAOZZN
7-1-45	SS-3100551-501	23386	@ Rod Assy, Ground	0001		PAOZZN
7-1-46 (W9)	SS-4500108-501	23386	@ Cable Assembly, TR 240 V	0001		PAOZZN
7-1-47 (W9)	SS-4500107-501	23386	@ Cable Assembly, TR 120 V	0001		PAOZZN
7-1-48 (W9)	SS-4500109-501	23386	@ Cable Assembly, TR 10-32 V.....	0001		PAOZZN
7-1-49	275-160-100-000	52473	@ Case, Transit, Diplexer ..... (23386/SS-1600352-2) (SPEC CTRL DRW)	0001		PAOZZN
7-1-50	IC-3300RC	82820	@ Cover, Frame ..... (23386/SS-1600354-1) (SPEC CTRL DRW)	0001		PAOZZN

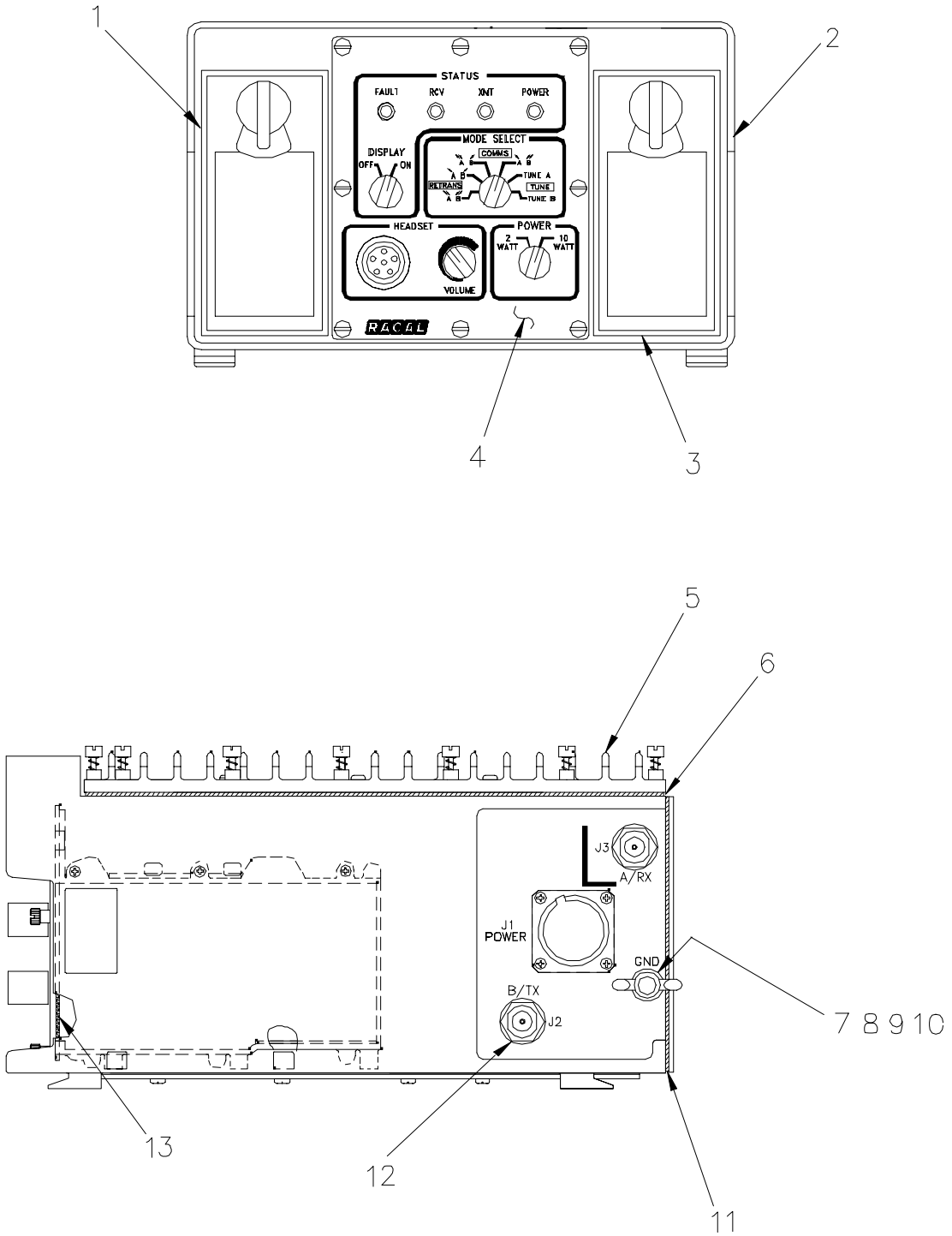
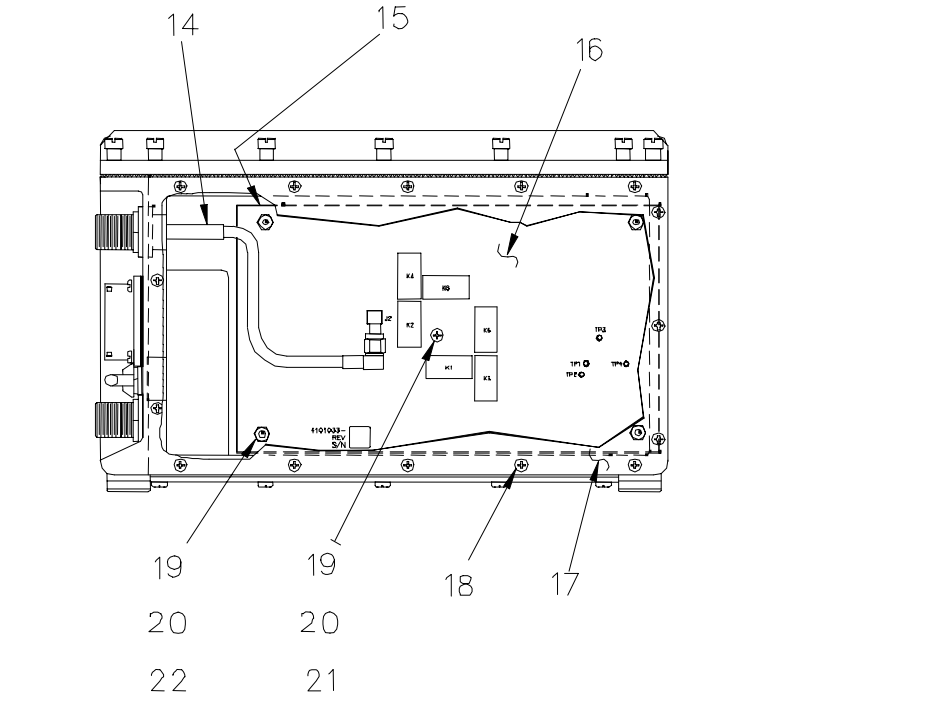


Figure 7-2. Bi-Directional Repeater Assembly (4101027-501) (Sheet 1 of 3)



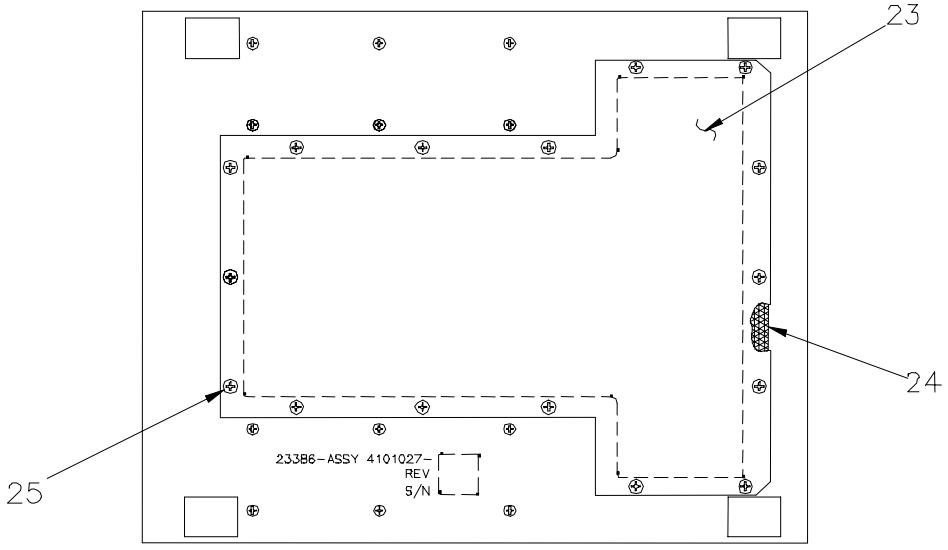


Figure 7-2. Bi-Directional Repeater Assembly (4101027-501) (Sheet 2 of 3)

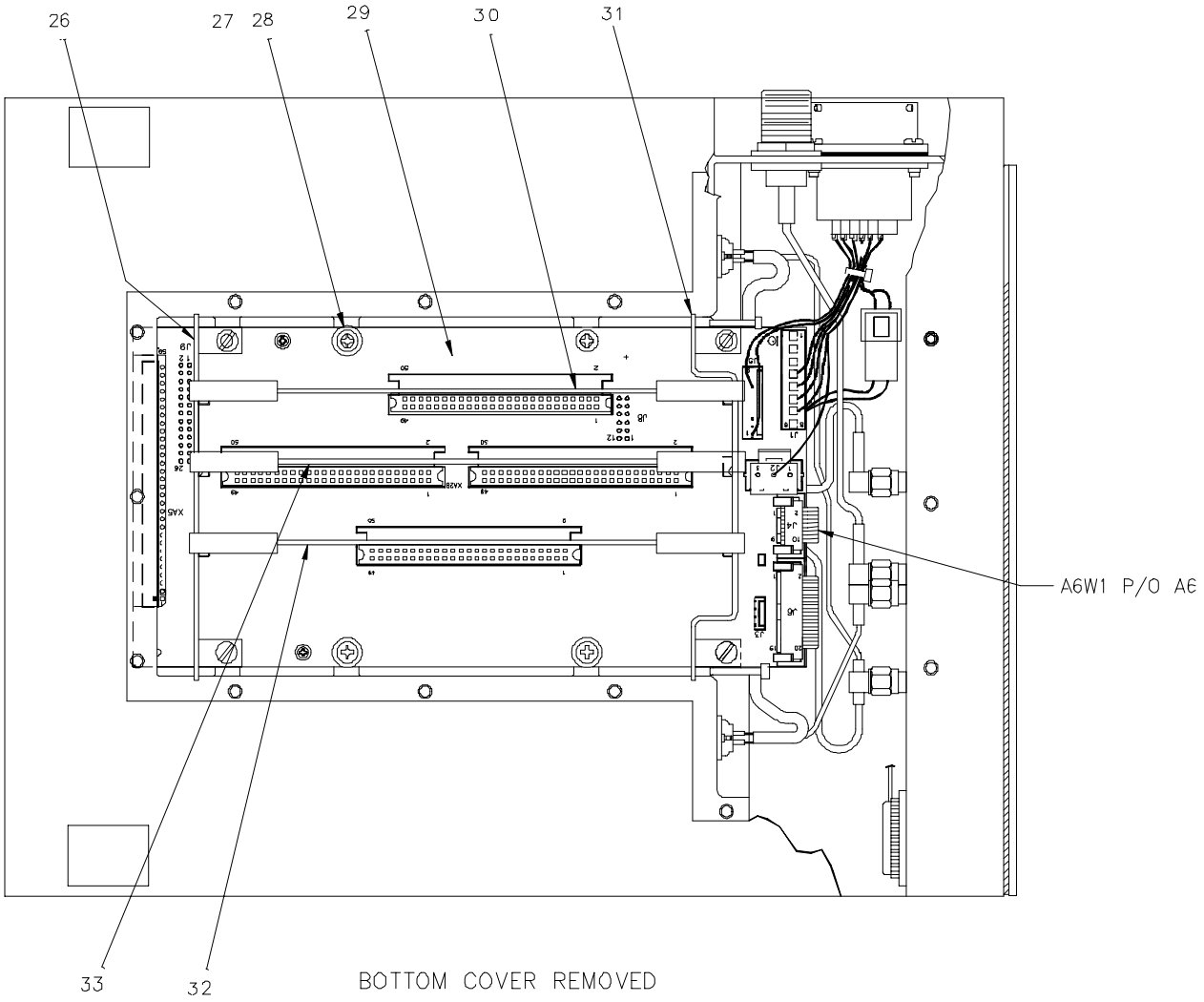


Figure 7-2. Bi-Directional Repeater Assembly (4101027-501) (Sheet 3 of 3)

Table 7-2. Bi-Directional Repeater Assembly (4101027-501)

Figure & Index No.	Part Number	CAGE	Description 1 2 3 4 5 6 7	Units per Assy	Usable on Code	SMR Code
7-2	4101027-501	23386	Bi-directional Repeater Assembly ..... (refer to Figure 7-2 for breakdown) (ESD)	0001		PAOLDT
7-2-1 (A8)	SS-4100823-502	23386	@ Sleeve Assembly, Short	0001		PADZZN
7-2-2	4600070-501	23386	@ Chassis Assembly, Altered	0001		XB
7-2-3 (A9)	SS-4100823-502	23386	@ Sleeve Assembly, Short	0002		PADZZN
7-2-4 (A5)	4101030-501	23386	@ Panel Assembly, Control	0001		PAOLDT
7-2-4a	4101032-501	23386	@@ CCA, Panel, Control (ESD).....	0001		PADZZN
7-2-5 (A6)	SS-4100853-501	23386	@ Power Amplifier Assembly (ESD)..... (refer to T.O 31R2-2TRC199-3 for breakdown)	0001		PAOLDT
7-2-6	SS-4400220-1	23386	@ Gasket, EMI.....	0001		PADZZN
7-2-7	5710-54-25	86928	@ Washer, Flat..... (23386/75106) (SPEC CTRL DRW)	0001		PADZZN
7-2-8	MS15795-810	96906	@ Washer, Flat..... (23386/75029) (SPEC CTRL DRW)	0001		PADZZN
7-2-9	MS35333-74	96906	Washer, Int Tooth..... (23386/SS-75066) (SPEC CTRL DRW)	0001		PADZZN
7-2-10	71206	73734	@ Nut, Wing ..... (23386/SS-754007) (SPEC CTRL DRW)	0001		PADZZN
7-2-11	SS-4400226-1	23386	@ Gasket, EMI.....	0001		PADZZN
7-2-12 (W2)	2500145-502	23386	@ Cable, Coaxial, Shield	0001		PADZZN
7-2-13	SS-3400331-1	23386	@ Gasket, EMI.....	0001		PADZZN
7-2-14 (W4)	SS-2500120-501	23386	@ Cable Assy, Coaxial.....	0001		PADZZN
7-2-15	4101047-501	23386	Mounting Plate Assy.....	0001		PADZZN
7-2-16 (A7)	4101033-501	23386	@ CCA, RF Matrix BDR (ESD).	0001		PADZZN
7-2-17	SS-3400357-1	23386	@ Cover, Rear.....	0001		XB
7-2-18	MS24693-C3	96906	Screw, Flat Head..... (23386/77813)(SPEC CTRL DRW)	0015		PADZZN
7-2-19	AN960-C4	88044	@ Washer, Flat..... (23386/75023) (SPEC CTRL DRW)	0026		PAFZZN
7-2-20	MS35338-135	96906	@ Washer, Lock..... (23386/75002) (SPEC CTRL DRW)	0026		PADZZN
7-2-21	MS51957-14	96906	@ Screw, Machine ..... (23386/77614) (SPEC CTRL DRW)	0004		PADZZN

Figure & Index No.	Part Number	CAGE	Description 1 2 3 4 5 6 7	Units per Assy	Usable on Code	SMR Code
7-2-22	NAS671C4	80205	Nut, Plain Hex (23386/75203)(SPEC CTRL DRW)	0004		PADZZN
7-2-23	SS-4100878-501	23386	Cover Assy, Bottom	0001		XB
7-2-24	SS-4400219-1	23386	Gasket, EMI	0001		PADZZN
7-2-25	MS3212-13	96906	Screw, Panhead (23386/79144-632-06) (SPEC CTRL DRW)	0016		PADZZN
7-2-26	SS-3100531-502	23386	Bracket Assy, Retaining	0001		XB
7-2-27	MS15795-806	96906	Washer, Flat (23386/75025) (SPEC CTRL DRW)	0004		PADZZN
7-2-28	MS51957-28	96906	Screw, Machine (23386/77628) (SPEC CTRL DRW)	0004		PADZZN
7-2-29 (A4)	SS-4100811-501	23386	CCA, Parent Board (ESD)	0001		PADZZN
7-2-30 (A1)	SS-4100730-501	23386	CCA, Converter +15V (ESD)	0001		PADZZN
7-2-31	SS-3100532-502	23386	Bracket Assy, Retaining	0001		XB
7-2-32 (A3)	4101050-501	23386	CCA, Repeater Interface	0001		PADZZN
7-2-33 (A2)	4101029-501	23386	CCA, Control, Repeater BDR (ESD) (refer to T.O 31R2-2TRC199-3 for breakdown)	0001		PAOLDT

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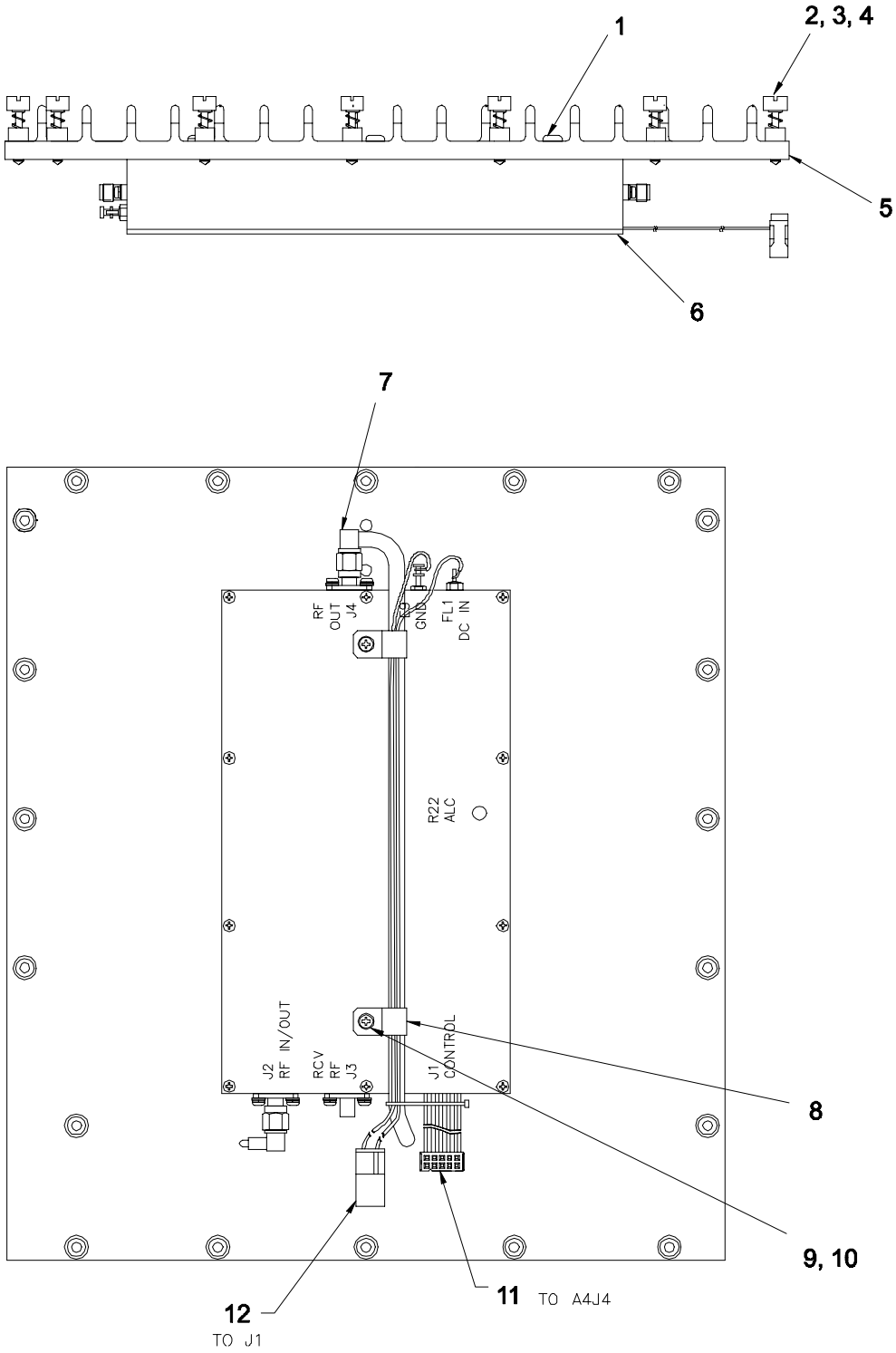

Figure 7-3. Power Amplifier Assembly, 15W (SS-4100853-501)

Table 7-3. Power AMP Assembly, 15W (SS-4100853-501)

Figure & Index No.	Part Number	CAGE	Description 1 2 3 4 5 6 7	Units per Assy	Usable on Code	SMR Code
7-3	SS-4100853-501	23386	Power Amplifier Assy, 15W (ESD).....	0001		PAOLDT
7-3-1	MS3212-15	96906	@ Screw, Machine ..... (23386/79144-632-08) (SPEC CTRL DRW)	0006		PADZZN
7-3-2	1026-250-SS-26	40337	Retainer, Panel Screw.....	0020		XB
7-3-3	107-SS-26	40337	Screw, Captive, Panel.....	0020		XB
7-3-4	1055-SS	40337	Spring, Panel Screw.....	0020		XB
7-3-5	SS-4100836-501	23386	@ Cover, Heatsink, TR	0001		XB
7-3-6	SS-4100855-501	23386	@ Amplifier Assy,15W (ESD)..... (refer to T.O. 31R2-4-1085-5 for breakdown)			
7-3-7 (W9)	2500147-501	23386	@ Cable Assy, Coaxial.....	0001		PADZZN
7-3-8	F4NY-312BK	85480	@ Cable, Clamp ..... (23386/81254) (SPEC CTRL DRW)	0002		PADZZN
7-3-9	AN960-C4	88044	@ Washer, Flat..... (23386/75023) (SPEC CTRL DRW)	0002		PADZZN
7-3-10	MS51957-14	96906	@ Screw, Machine ..... (23386/77614) (SPEC CTRL DRW)	0002		PADZZN
7-3-11 (A6W1)	SS-3500281-501	23386	Cable Assy, Amplifier Control	0001		PADZZN
7-3-12 (A6W9)	SS-2500122-501	23386	Cable Assy, Amplifier Power	0001		PADZZN

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1026-250-SS-26	7-3-2	AN960-C4	7-3-9	MS51957-84	7-1-10
1055-SS	7-3-4	AN960-C4	7-2-19	MS51957-85	7-1-35
107-SS-26	7-3-3	AR31EF	7-1-39d	MS51957-87	7-1-22
2500145-502	7-2-12 (W2)	CPRG223/U-30-XX	7-1-42 (W10)	MS51958-61	7-1-25
2500147-501	7-3-7 (W9)	DG33640	7-1-39j	MS51958-73	7-1-20
275-160-070-000	7-1-44	F209	7-1-39g	NAS671C4	7-2-22
275-160-100-000	7-1-49	F4NY-312BK	7-3-8	Q86	7-1-39k
4101025-501	7-1	IC-3300RC	7-1-50	SL/33644	7-1-39a
4101027-501	7-2	MS15795-806	7-2-27	SL32223	7-1-39h
4101027-501	7-1-1 (A1)	MS15795-810	7-2-8	SL33641SH1	7-1-39b
4101028-501	7-1-21 (A2)	MS15795-810	7-1-9	SL33641SH2	7-1-39c
4101029-501	7-2-33 (A2)	MS15795-842	7-1-17	SL33642-1	7-1-39l
4101030-501	7-2-4 (A5)	MS21318-20*	7-1-4	SP10SS	7-1-39
4101032-501	7-2-4a	MS21919WDG4	7-1-29	SS-1600322-501	7-1-33 (A3)
4101033-501	7-2-16 (A7)	MS21919WDG7	7-1-26	SS-1600322-502	7-1-33 (A3)
4101047-501	7-2-15	MS24693-C3	7-2-18	SS-1600322-503	7-1-33 (A3)
4101050-501	7-2-32 (A3)	MS3212-13	7-2-25	SS-2400577-1	7-1-27
4242-MK2-RAC	7-1-41	MS3212-15	7-3-1	SS-2400578-1	7-1-24
4265-RAC	7-1-40	MS35333-74	7-2-9	SS-2400605-2	7-1-3
4266-RAC	7-1-38	MS35338-135	7-2-20	SS-2500120-501	7-2-14 (W4)
4500117-501	7-1-32 (W1)	MS35338-138	7-1-16	SS-2500122-501	7-3-12 (A6W9)
4600070-501	7-2-2	MS35338-139	7-1-8	SS-3100531-502	7-2-26
5710-54-25	7-2-7	MS35650-104	7-1-15	SS-3100532-502	7-2-31
5712-61-63*	7-1-36	MS35690-410	7-1-13	SS-3100546-501	7-1-6
71206	7-1-14	MS51957-14	7-3-10	SS-3100551-501	7-1-45
71206	7-2-10	MS51957-14	7-2-21	SS-3100552-501	7-1-43

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9268-A257-16	7-1-28	SS-3500292-505	7-1-31 (W4)	SS-4400225-1	7-1-5
9286-A194-16AB	7-1-18	SS-4100730-501	7-2-30 (A1)	SS-4400226-1	7-2-11
MS51957-28	7-2-28	SS-4100807-512	7-1-2 (A4, A5)	SS-4500107-501	7-1-47 (W9)
MS51957-79	7-1-7	SS-4100811-501	7-2-29 (A4)	SS-4500108-501	7-1-46 (W9)
SS-3400331-1	7-2-13	SS-4100823-502	7-2-3 (A9)	SS-4500109-501	7-1-48 (W9)
SS-3400353-1	7-1-19	SS-4100823-502	7-2-1 (A8)		
SS-3400355-1	7-1-37	SS-4100836-501	7-3-5		
SS-3400357-1	7-2-17	SS-4100853-501	7-2-5 (A6)		
SS-3500279-502	7-1-34 (W5)	SS-4100853-501	7-3		
SS-3500279-503	7-1-12 (W6)	SS-4100855-501	7-3-6		
SS-3500279-504	7-1-11 (W7)	SS-4100878-501	7-2-23		
SS-3500281-501	7-3-11 (A6W1)	SS-4400219-1	7-2-24		
SS-3500292-503	7-1-23 (W3)	SS-4400220-1	7-2-6		
SS-3500292-504	7-1-30 (W2)				

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A3	7-1-33				
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W2	7-1-30				
W3	7-1-23				
W4	7-1-31				
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A5	7-2-4				
A6	7-2-5				
A7	7-2-16				
A8	7-2-1				

Section V. COMMON BULK ITEMS LIST

Part Number	CAGE Code	Description	Unit of Measure
No 222 50CC	05972	Threadlocking Compound No. 222 (23386/91172)	A/R

CHAPTER 8 CIRCUIT DIAGRAMS

8-1 SCOPE

This chapter contains the following diagram:

Figure No.	Title
8-1	Radio Set AN/TRC-207, Interconnection Diagram

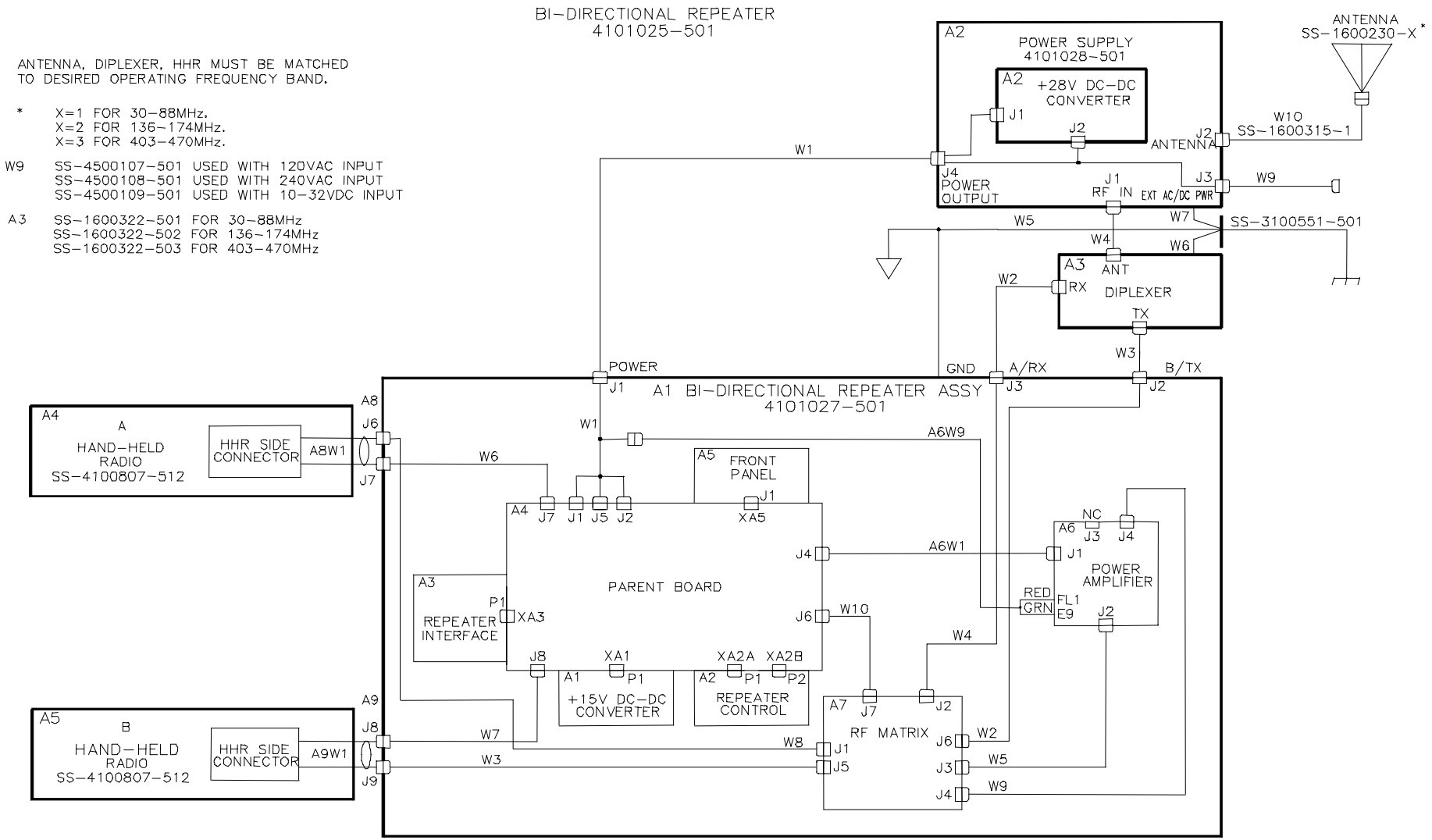

Figure 8-1. Radio Set AN/TRC-207, Interconnection Diagram

GLOSSARY

AC	Alternating current
ALC	Automatic level control
ANT	Antenna
ASSY	Assembly
BDR	Bi-directional Repeater
C	Celsius (centigrade)
CCA	Circuit card assembly
CCI	Controlled cryptographic item
CLR	Clear
CM	Centimeter
CTCSS	Continuous tone-controlled squelch system
CTRL	Control
CW	Continuous wave
dB	Decibels
dBi	Decibel (isotropic)
dBD	Decibels relative to a 1/2 wavelength dipole
dBm	Power in decibels (referenced to 1 milliwatt)
DC	Direct current
DRW	Drawing
ESD	Electrostatic discharge
ESDS	Electrostatic discharge sensitive
EXT	External
F	Fahrenheit
FM	Frequency modulation (modulated)
GND	Ground
HF	High frequency
HZ	Hertz
IF	Intermediate frequency
in.	Inch
INT	Internal
kbps	Kilobits/second
kg	Kilogram
kHz	Kilohertz
Lbs	Pounds
LED	Light emitting diode
MHz	Megahertz
NiCad	Nickel Cadmium
PTT	Push-to-talk
RCV	Receive
RX	Receiver
SINAD	Signal + noise + distortion power/noise + distortion power, expressed in dB
SPEC	Specification
SMR	Source, Maintenance and Recoverability
TUNERX	Tune receiver
TUNETX	Tune transmitter
TX	Transmitter
UHF	Ultra high frequency
V	Volt
VAC	Volts alternating current
VHF	Very high frequency
W	Watt

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